
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

GoogleTM books

<https://books.google.com>





MAR 18 1918

No. 1.

January, 1918.

Vol. XXX.

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL W. H. HORROCKS, C.B.

ASSISTED BY

LIEUT.-COLONEL D. HARVEY, C.M.G., R.A.M.C.

ISSUED MONTHLY



Printed and Published by

JOHN BALE, SONS & DANIELSSON, LTD.

OXFORD HOUSE

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

Price Two Shillings net.

THE TREATMENT OF VENEREAL DISEASES.

Recurrent Fever
SYPHILIS

GALYL

Framboesia
Sleeping Sickness

Practical work with GALYL in the shape of **60,000 INTRAVENOUS** (dilute and concentrated) and **INTRAMUSCULAR INJECTIONS** administered in Military, Naval, and the principal General Hospitals throughout the United Kingdom, has demonstrated that this preparation is **more rapid and less toxic** in action than any compound of the "606" group, which accounts for the **consistently excellent clinical results** without any undesirable by effects.

The other advantages of GALYL are:

1. Distilled water only necessary for making the solution.
2. GALYL can be injected in the dilute or concentrated form—intravenously—or in Glucose Solution—intramuscularly.
3. GALYL is a true Anti-syphilitic, as shown by the results of the Wassermann test, but contains a smaller percentage of Arsenic than any of the compounds of the "606" group.

FORMS:

FOR INTRAVENOUS INJECTIONS:—

(1) **DILUTE.**—GALYL is supplied in neutral glass ampoules containing the necessary dose of Sodium Carbonate, sterile distilled water only being used for the dissolution:

(2) **CONCENTRATED.**—A special outfit containing one dose GALYL, one ampoule sterilised solution, and one small filter is supplied.

Doses:—
0.10 — 0.15 — 0.20 — 0.25 — 0.30 —
0.35 — 0.40.

(3) **FOR INTRAMUSCULAR INJECTIONS:—**

GALYL is supplied in **GLUCOSE SOLUTION.**

Doses:—
0.10—0.15—0.20—0.30—0.40

LITERATURE, CLINICAL REPORTS, and PRICE LIST on REQUEST.

THE ANGLO-FRENCH DRUG CO., Ltd. (Late M. Bressillon & Co.),
Gamage Building, Holborn, London, E.C.

Telephone: Holborn 1811.

Telegrams: "AMPALVAR, LONDON."

The TREATMENT OF CARBUNCLES, BOILS, ANTHRAX,
ACNE, STYES, and Diseases arising from Staphylococcus.

STANNOXYL

(An Oxide of Tin and Tin Metal Free from Lead.)

A scientific production the value of which has been studied very closely. The effect is very prompt; from the second day of treatment the pain is relieved, the carbuncles begin to dry up, and those which are just opening are stopped in their course; the core is not expelled but reabsorbed.

In the majority of cases definite results are obtained within five or six days; it is seldom necessary to take the full ten days' treatment, and relapses are unknown.

The daily dose for adults is 4 to 8 tablets; children 2 to 4 tablets.
Supplied in vials of 80 tablets.

The SCIENTIFIC TREATMENT of INFLUENZA and Allied Ailments.

KINECTINE

According to Dr. MOUNEYRAT, the discoverer of Galyl (the widely adopted Salvarsan Substitute).

FORMULA:— Chlorhydrate of Quinine c. Hectine—i.e., Benzo-sulfone-para-amino-phenyl-arsenate of Quinine.

Non-toxic, produces no ill results. Easily taken (tablets) and well tolerated.
Highly satisfactory clinical results.

Not only a prophylactic against, but a specific in **INFLUENZA, MALARIA, Catarrh, Coryza, NEURALGIA, HAY FEVER, &c.**

H.M.S. ——— 27.7.17.

Sir,—I enclose P.O. for the tube of Kinctine. The drug has given every satisfaction.
The Anglo-French Drug Co., Ltd., Holborn, London, E.C.

W. B. H. W., Surgeon, R.N.

Journal
of the
Royal Army Medical Corps

Journal

OF THE

Royal Army Medical Corps

EDITED BY
COLONEL W. H. HORROCKS, C.B.

ASSISTED BY
LIEUT.-COLONEL D. HARVEY, C.M.G., R.A.M.C.

VOL. XXX.
January—June, 1918.



JOHN BALE, SONS & DANIELSSON, LTD.
OXFORD HOUSE
83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

BIOLOGY
LIBRARY
G

BY THE
LIBRARY

UNIV. OF
CALIFORNIA

Journal
of the
Royal Army Medical Corps.

Original Communications.

IDENTIFICATION OF THE MENINGOCOCCUS.

BY LIEUTENANT-COLONEL M. H. GORDON, C.M.G.
Royal Army Medical Corps.

I.—PRELIMINARY RESEARCHES.

DURING the years 1903 and 1904, while engaged upon an investigation of the micro-organisms present in saliva, I had frequent occasion to make a quantitative bacteriological examination of this material. The object then in view was to define the bacteria that are most numerous in the mouth in order to obtain a test that could be applied to detect particulate pollution of air by material derived from the upper respiratory passages, in a way similar to that in which *Bacillus coli* is used to detect and measure excremental pollution of water. While certain streptococci were found to provide the index in question, particularly *Streptococcus salivarius* (which is constantly present to the extent of ten to one hundred millions per cubic centimetre of normal saliva) it was observed that among other bacteria present in the cultures were certain Gram-negative cocci, which frequently exceeded 100,000 per cubic centimetre of the saliva of normal individuals.

In 1905, in view of the recent occurrence of cerebrospinal fever abroad in epidemic form, and the discovery that this disease is spread by persons who carry the meningococcus in their nasopharynx, it appeared desirable to define the characters of these Gram-negative cocci of normal saliva more closely, so that should occasion arise hereafter the information might be available for identifying "carriers" of the meningococcus.

Accordingly, an investigation of these Gram-negative cocci was undertaken, and it was soon obvious that they were of several different kinds. As my object was to sort them, and previous experience with streptococci had shown that this was most likely to be achieved by a study of their

fermentative characters, representative specimens of the Gram-negative cocci were isolated and cultivated in a slightly alkaline medium containing one or other of some sixty carbohydrates, polyatomic alcohols or glucosides. As a result it was found that glucose, maltose, saccharose and galactose, were of value for differentiating these salivary Gram-negative cocci from one another, and by means of their ability to break up one or other of these carbohydrates 127 Gram-negative cocci derived from human saliva were resolved into five separate groups. To make the investigation complete, the meningococcus and gonococcus were also examined with regard to their behaviour in these tests, and the points in which they differ from each other and from the Gram-negative cocci of normal saliva defined.

In addition to the difference in respect of fermentative characters, it was found that the question of growth or no growth on agar or nasgar at 23° C. was a further point of practical value for the purpose of differentiating these Gram-negative cocci from the meningococcus, which, as Albrecht and Ghon first showed in 1901, does not grow on ordinary media below a temperature of 25° C.

While this investigation was at an early stage, I was invited by Dr. R. A. Dunn, Medical Officer of Health, of East Herts, to co-operate with him in an investigation of a mysterious illness of an infectious nature which had appeared in the district for the health of which he was responsible. This illness was at one time suspected of being cerebrospinal fever, and in course of the bacteriological investigation of material from the nasal passages of persons affected by it, my collection of Gram-negative cocci became considerably augmented. The chief micro-organism found in the nasal secretion of the Herts cases was *Micrococcus catarrhalis*, but among other Gram-negative cocci encountered were some that resembled the meningococcus more closely than the majority of those which I had previously come across in cultures from normal saliva. On proceeding to compare certain of these cocci with the meningococcus, it was discovered that even when the sugars previously mentioned failed to differentiate them, the majority were clearly distinguishable from the meningococcus by their ability to ferment mannose; moreover, all of them were distinguished from it by the fact that they grew readily upon nasgar at 23° C.

Up to the time of this investigation, attempts had been made with variable success by several observers to apply the agglutination test for the purpose of differentiating the meningococcus. My own efforts in this direction were not of an encouraging nature, and therefore I was unable to recommend the test at this stage of the research. Looking back, it is easy to see now that two of the chief reasons of this early lack of success were, first, that I employed the microscopic method only, and secondly, that the most satisfactory way to prepare agglutinin for the meningococcus had not then been determined.

The conclusion reached, therefore, was that the Gram-negative cocci of normal saliva were of several different kinds, and the characters of most

value for differentiating them from the meningococcus were the appearance of their growth on agar or nasgar at 37° C., their ability to grow on nasgar at 23° C. to 25° C., and their action upon glucose, maltose, galactose and saccharose respectively, and, in certain cases, mannose. The value of these fermentation tests for the purpose in view was subsequently confirmed by others, notably by von Lingelsheim, whose results appeared in the year following that of the publication of the paper by Dunn and myself.

Shortly after this investigation had been completed, I was fortunate enough to secure the co-operation of Sir T. J. Horder in an experimental investigation of the protective value of various samples of antimeningococcus serum. It is unnecessary to describe this investigation further here than to remark that we found that whereas the total growth of as much as six young slope cultures on nasgar of the particular meningococcus with which we were working could be injected intravenously in a single dose into a rabbit without fatal effect, nevertheless a total of but four to six of such cultures was invariably fatal to the animal, if given *seriatim*, and an hour's interval was allowed to elapse between the injection of each individual culture. The experience then gained with this method of saturation proved of very great value some eight years after.

II.—MEASURES ADOPTED FOR IDENTIFICATION OF THE MENINGOCOCCUS ON THE MANIFESTATION OF CEREBROSPINAL FEVER AMONG TROOPS IN TRAINING DURING 1915.

In the early months of 1915 cerebrospinal fever broke out among recruits in training, a large epidemic was threatened, and special measures became imperative for limiting the spread of this disease. The sanitary measures adopted for this purpose were directed by Colonel W. H. Horrocks, C.B., K.H.S., who was assisted by Surgeon-Colonel R. J. Reece, C.B., and I was invited by the Medical Research Committee to advise with regard to bacteriological matters, and also to carry out research. The following procedure was adopted: On occurrence of a case of cerebrospinal fever, the patient was removed to an isolation hospital for treatment, and the contacts were segregated and swabbed. Each contact whose nasopharynx yielded no meningococcus-like organisms was returned to duty with the smallest possible delay, while those whose nasopharynx was found to contain an organism resembling the meningococcus were kept in isolation until the characters of the suspect coccus had been further determined. Thus it was ensured that contacts whose nasopharynx yielded an organism indistinguishable from the meningococcus were kept in isolation until two consecutive nasopharyngeal swabs taken at an interval of several days proved negative.

A central laboratory was set up at the Royal Army Medical College, and district laboratories were started or co-opted for the purpose of dealing with this disease in military districts throughout the country. A special

department in the central laboratory was instituted for the manufacture and supply of media to the laboratories, and placed under the charge of Major T. G. M. Hine. For the purpose of obtaining material from the nasopharynx for bacteriological examination, the covered swab introduced by Mr. C. E. West, F.R.C.S., was adopted.

From the bacteriological point of view, the immediate need was for a practical and rapid method of identifying the meningococcus in the nasopharyngeal secretion, while it was essential that the procedure adopted should be of such a nature that the bacteriologists who were detailed or co-opted for this work—most of whom had little or no previous experience of identifying the meningococcus in nasopharyngeal secretion—could readily carry it out with the appliances of an ordinary bacteriological laboratory.

In the memorandum which was issued in February, 1915, giving instructions as to the measures to be taken on the occurrence of a case of cerebrospinal fever, and the mode of passing the nasopharyngeal swab, the following procedure was prescribed for identification of the meningococcus.

"Secretion from the nasopharynx. The stages of the investigation are as follows:—

"(1) Examination of separate colonies on the cultures. Colonies of the meningococcus appear at 37° C. in twenty-four to forty-eight hours. They are larger than colonies of the accompanying pneumococci and streptococci; they are clear, smooth and transparent, have a firm outline, and are very characteristic. A portion of one of these colonies taken up on a platinum needle is found to emulsify readily in a drop of water on a glass slide.

"(2) Gram's stain. A film made from one of these colonies shows Gram-negative diplococci.

"Subcultures are made and placed at 37° C. and at 23° C. respectively. The meningococcus does not grow at 23° C., whereas the vast majority of the Gram-negative cocci of normal saliva grow readily at this temperature.

"In view of the sharp distinction which this test provides, it will be sufficient for practical purposes to regard the suspicious cocci that have passed it as meningococci.

"Confirmatory tests should be employed for greater accuracy as follows:—

"*Fermentation Tests.*—The meningococcus ferments glucose with the production of an acid reaction, but fails to change saccharose. These tests are applied by making subcultures at 37° C. in media tinted with litmus and containing the above sugars respectively.

"*Agglutination.*—The meningococcus shows positive agglutination when brought in contact with anti-meningococcus serum."

This scheme of identifying the meningococcus in nasopharyngeal secretion had the advantage of simplicity and speed; moreover it was

found to work quite smoothly in practice. The majority of the contacts were found to harbour no meningococcus-like organisms, and were returned to duty within forty-eight hours.

It was plain, however, at the outset that the bacteriological procedure was of a provisional nature only, and that while it made practical application of the knowledge then available for the exclusion of the commoner Gram-negative cocci with which confusion was likely to arise, there was reason to suspect the possible existence of a further group of these organisms indistinguishable from the meningococcus in the particular characters submitted to scrutiny, but without the same significance in regard to epidemic cerebrospinal fever.

The history of bacteriology in its application to medicine shows repeated instances of the confusion of specific pathogenic bacteria with others closely resembling them in morphological, cultural, and sometimes even in fermentative characters also, but entirely devoid of the same pathogenic significance. The earliest instance in which this similarity led to error appears to have been brought about by the resemblance between the anthrax bacillus and *B. subtilis*. The similarity between the diphtheria bacillus and certain diphtheroid bacilli is another example that has certainly led to mistakes, and the resemblance in morphological and cultural characters between the cholera vibrio and some other vibrios found in nature has undoubtedly caused difficulty in the past. The history of the attempts to identify the typhoid bacillus in water is a further and striking illustration of the need of caution before resting satisfied that a given micro-organism is identical with one of specific pathogenic importance solely because of a close resemblance in morphological, cultural, and fermentative characters.

Accordingly, it was realized at the outset that the procedure adopted for recognizing the meningococcus in nasopharyngeal secretion merely represented the best that could be done in the circumstances, and that the only way to define and remedy its possible defects was by intensive research. This research was rendered still more urgent by the military necessity of holding up no man, unless he carried a meningococcus of known epidemic significance.

III.—DEFINITION OF THE MENINGOCOCCUS OF THE OUTBREAK BY MEANS OF THE AGGLUTINATION TEST.

In view of the work that had been done by Jochmann, Von Lingelsheim, Lieberknecht, Kutscher, Dopter, Netter and Debré, Elser and Huntoon, Raymond Koch, and others, and the improvements in knowledge and technique that had resulted from their labours, it was anticipated that the agglutination test would prove of immediate use for the purpose of identifying the meningococcus. On trial, however, it was found that specimens of the antimeningococcus serum then available failed to

agglutinate meningococci isolated from the cerebrospinal fluid of our cases.

Analysis of Meningococci occurring in the Cerebrospinal Fluid of the Cases.—Before an agglutinating serum could be obtained, therefore, that would serve for the purpose of identifying the micro-organism of the outbreak, it was necessary to start *ab initio*, and first of all to collect meningococci from the cerebrospinal fluid of the cases and to define them by the agglutination test. It was clear also from the work of Lieberknecht, Dopter, and Elser and Huntoon that the absorption test should be applied as well in order to check the results of simple agglutination.

The steps of this investigation have been described in detail in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, and also in a report to the Medical Research Committee. The first requirement was to obtain agglutinating serum of good quality in as short a time as possible. By means of the saturation method to which reference has been made, it was found that excellent agglutinating serum could be prepared from young rabbits within ten days. Meningococci were collected from the cerebrospinal fluid of thirty-two cases of the disease and systematically investigated by Captain E. G. Murray and myself in respect of their agglutination reactions, and the results checked by the absorption test. In view of the work of Kutscher and Lieberknecht, the macroscopic method was used, and the tubes examined after twenty-four hours at 55° C. From the first, the method was standardized. Raymond Koch's discovery that a suspension of meningococci would keep for several months in saline, and serve quite well for agglutination tests, provided it is heated in the first place for half an hour to 65° C., and 0.5 per cent of phenol then added as a preservative, was made use of, and all suspensions standardized to contain the same number of meningococci by a turbidity test that was worked out for this purpose. In order that our results might be checked by others, full particulars have been given of the procedure employed.

As the outcome of this investigation, the thirty-two meningococci were found to be resolved into four different groups as follows :—

Type ..	1	2	3	4
Specimens	19	8	4	1

As a rule, the results of simple agglutination carried out in the usual quantitative fashion were confirmed by those given by the absorption test. There were in some cases close affinities between members of Types 1 and 3, and 2 and 4, but absorption tests proved that these affinities were due to minor or co-agglutinins, and that the major agglutinin of each of the four types was univalent and specific. Complete cross tests and controls were carried out with all thirty-two cocci against each of the four univalent sera.

IV.—APPLICATION OF THIS INFORMATION FOR THE PURPOSE OF IDENTIFYING THE MENINGOCOCCUS IN NASOPHARYNGEAL SECRETION.

Gram-negative cocci from the nasopharynx of nine contacts and one doubtful case of cerebrospinal fever were now submitted to investigation with the four univalent agglutinating sera that had been proved to include all of the serological types of meningococcus occurring in the cerebrospinal fluid of the thirty-two cases. Each of these ten nasopharyngeal cocci was indistinguishable from the meningococcus in morphological, cultural, and fermentative characters. As a result of the test, six of these nasopharyngeal cocci were found to be serologically identical with the meningococcus—five being specimens of Type 2, and one of Type 1. The remaining four nasopharyngeal cocci could not be identified serologically with any of the four types of meningococcus. In order to test the matter further, two specimens of these four pharyngococci were injected into rabbits and an agglutinating serum prepared against each of them. The specific agglutinin of each of the pharyngococci, while readily removed by the homologous coccus, was quite unaffected by any of the four types of meningococcus obtained from the cerebrospinal fluid of the cases. The two pharyngococci in question also appeared to be serologically distinct from one another. Thus the suspicion mentioned previously was confirmed and the existence established of a group of pharyngococci indistinguishable from the meningococcus in the morphological, cultural and fermentative characters submitted to examination, but nevertheless distinct serologically from any of the types of meningococcus present in the cerebrospinal fluid of the thirty-two cases of cerebrospinal fever.

V.—ROUTINE ADOPTION OF THE AGGLUTINATION TEST FOR THE PURPOSE OF IDENTIFYING THE MENINGOCOCCUS IN CASES OR IN CONTACTS.

During the autumn of 1915 further specimens of meningococcus from the cerebrospinal fluid of cases were submitted to scrutiny with the four univalent sera. For this purpose Major Arkwright generously supplied me with cultures from the collection which he had made during preceding stages of the outbreak, and Dr. O'Brien did the same. As a result, by the end of 1915 over sixty specimens of meningococcus had been examined with all four agglutinating sera, and found to be identical with one or other of the four serological types.

As soon as the types of meningococcus present in the outbreak had been defined, cultures of them were forwarded to those who prepare anti-meningococcus serum, with a note as to their frequency. In order also to make the identification of the meningococcus more accurate, it was decided to provide all district laboratories with the necessary materials for determining the type present either in the cases or in contacts. Major Hine carried out a research in which he defined the relative value of various modes of dosage for the purpose of obtaining agglutinating serum for the

meningococcus in the shortest possible time, and by this means elaborated an intensive method which has now been in continual use at the Central Laboratory for over two years with uniform success. The manufacture and supply of univalent agglutinating sera and emulsions was taken over by him, and these were supplied to district laboratories in outfits, the expense of which was defrayed by the Medical Research Committee. With each outfit the following directions were issued:—

CEREBROSPINAL FEVER.

AGGLUTINATION TESTS.

Directions for Applying the Agglutination Test to Meningococci and Meningococcus-like Organisms with the Outfit supplied for this Purpose from the Central Cerebrospinal Fever Laboratory, Royal Army Medical College, S.W.

December 20, 1915.

Investigation of meningococci occurring in the recent outbreak of cerebrospinal fever among the troops in this country has shown that the majority of specimens of this micro-organism isolated from the cerebrospinal fluid of the cases, although alike in cultural and fermentative characters, are differentiated by the agglutination test into one or other of three main types.

The relative abundance of each of these types up to the present stage of investigation of the recent outbreak is seen from the following figures. The number of specimens of meningococci from cerebrospinal fluid examined was sixty-one:—

Type	Specimens			Percentage	
1	31	..	50
2	20	..	32
3	10	..	16

In addition to these three predominant types, several other types of meningococcus have been differentiated by the same means, but the latter, owing to their comparative rarity so far, appear to be relatively unimportant from the point of view of controlling the epidemic among troops.

The above facts have a practical bearing both on treatment and also on identification of the meningococcus in the nasopharynx of carriers.

Serum Treatment of the Patient.—In order to ensure that the correct specific serum is given, it is desirable to prepare a suspension of the particular meningococcus occurring in the cerebrospinal fluid of the case, and to determine its type by the agglutination test.

Identification of the Meningococcus in the Nasopharynx of Carriers.—According to present evidence, cerebrospinal fever is chiefly spread by carriers. In order to check the spread of this disease, therefore, it is desirable to detect and isolate any persons carrying in their nasopharynx known epidemic strains. Recognition of such strains of this micro-organism is now possible by means of the agglutination test.

Method recommended for applying the Test.—The following articles are required:—

(1) Specific agglutinating sera univalent for each of the three chief types of meningococcus occurring in the cerebrospinal fluid of cases during the present outbreak, and a sample of normal serum for use as control.

- (2) Four sterile test-tubes for making dilutions of these sera.
- (3) A fine-calibre pipette holding 0.5 cubic centimetre, and graduated to 0.1 cubic centimetre.
- (4) A five-cubic-centimetre pipette graduated in one-cubic-centimetre and 0.1-cubic-centimetre divisions up to the point.
- (5) Small test tubes three inches by $\frac{1}{4}$ inch sterilized and plugged with sterile wool.
- (6) A stand to hold these tubes. (See below.)
- (7) *Fresh* sterile saline (0.85 per cent.).
- (8) Standardized and phenolated suspensions of each of the meningococci homologous to the three specific sera, and similar suspensions of the several cocci to be tested.

When identifying the meningococcus in cultures from the nasopharynx, the first stage is the selection of meningococcus-like colonies in the plates after twenty-four hours' growth at 37° C. A colony sufficiently typical for further test having been carefully selected, the steps for carrying out the agglutination test are as follows:—

Preparation of Standard Suspension of Selected Coccus.—As the method recommended is the macroscopic one, it is necessary in the first place to obtain enough growth of the coccus to make a fair quantity of the suspension. The coccus, therefore, should be spread over the surface of two or more legumin agar plates, or plates of other suitable medium. After twenty-four hours' incubation at 37° C., the growth on each plate is washed off in five cubic centimetres of saline with the aid of a sterile wire or a glass rod bent to an angle, then poured into a sterile test tube and well shaken. Film preparations are next made of these suspensions, stained with Gram, and examined for purity. Meantime the tubes have been placed in a water bath at 65° C., at which temperature they are allowed to remain for thirty minutes, in order to kill the coccus and to destroy its autolysin.

Standardization of the Suspension.—This is effected in the following way: With a pipette delivering 0.1 cubic centimetre, this amount of the suspension is transferred to an ordinary clean $\frac{1}{4}$ -inch test tube specially kept for this purpose. Clear tap water is then run in from the five-cubic-centimetre graduated pipette until the contents of the tube are only just—but still definitely—turbid by daylight when compared with the control tube of tap water. This end-point is taken to represent a content of 100 millions of the coccus per cubic centimetre. A simple calculation then gives the number of cocci contained by the suspension. For example, if 0.1 cubic centimetre of the suspension requires to be diluted to 8 cubic centimetres with tap water to reach the end-point, 0.1 cubic centimetre of the suspension, therefore, contains 800 million cocci; and 1 cubic centimetre of it 8,000 million. Supposing there are 5 cubic centimetres of the suspension; this contains, therefore, 40,000 million cocci altogether. Now it has been found by experiment that a suspension of meningococcus containing 2,000 million per cubic centimetre gives excellent results as regards macroscopic agglutination. In the present example, then, there are sufficient cocci to make 20 cubic centimetres of such a standard suspension. Accordingly, the 5 cubic centimetres of suspension is poured into a sterile measuring glass, diluted with saline up to 18 cubic centimetres, and then 2 cubic centimetres of a 5 per cent solution of phenol in distilled water is added to it as a preservative. The suspension, heated, standardized, and

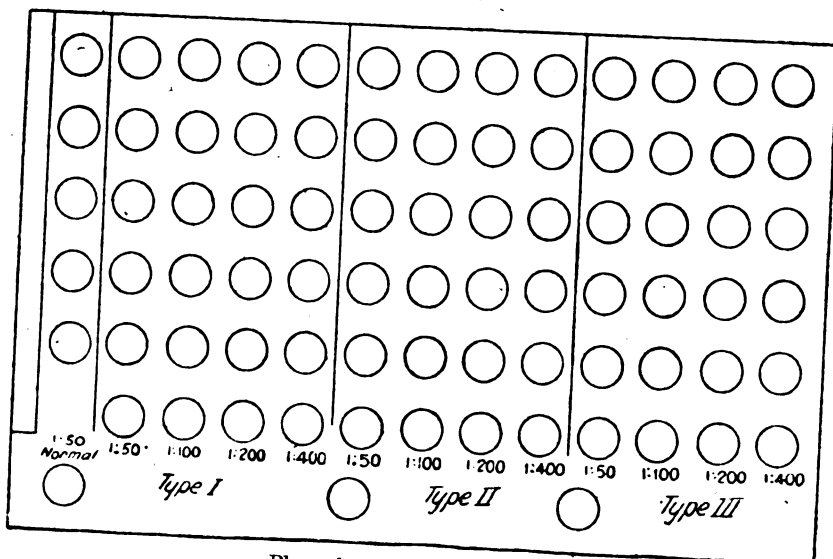
Identification of the Meningococcus

phenolated in this way, is poured into a bottle, labelled, and dated. It has been found that such suspensions of meningococci keep for several months.

The standardized suspensions having been prepared in this way, and the other articles being at hand, procedure is as follows: Let us imagine, for example, that five Gram-negative cocci are to be tested with the agglutinating sera prepared against the three chief types of meningococcus that have been obtained from the cerebrospinal fluid of epidemic cases.

Arrangement of Tubes in the Stand.—This stand is designed to hold enough tubes to test five different cocci at the same time against the three specific sera with the necessary controls.

In order to determine the degree of agglutination, the coccus is put up against each of these three sera in four dilutions. To prove that the three agglutinating sera are active, a control is also put up of each of them against its homologous coccus in the same dilutions. Thus eight cocci in all are tested, three known and five unknown. As an additional control, each coccus is also put up against a sample of normal serum.



The stand consists of a wooden block with six rows of thirteen cylindrical holes to contain the agglutination tubes. On the left is a xylonite strip for labelling each row. The holes are marked out in three blocks, stained amber, white, and blue respectively; each one of these coloured blocks contains twenty-four holes, and is assigned to a separate specific serum. In addition there is a vertical row of five holes labelled "Normal," and there are also three single holes at the bottom for controls of normal serum against the three "standard" cocci.

The dilutions of the several sera are first of all filled into the tubes in vertical rows; then the suspensions of the different cocci are added in turn to the horizontal rows.

Thus each of the three sera has a block of four vertical rows, and a single row is reserved for the normal serum on the left. Each coccus of test has one horizontal row which runs through all three blocks of specific area, starting with the row devoted to normal serum.

The standard suspensions and anti-sera issued are put up in amber, white and blue bottles and capsules for Types I, II and III respectively, corresponding to the three blocks of holes in the board. There is also a green capsule containing the normal serum.

Example of Test.—The following example will illustrate the procedure employed in further detail. The titre of all the three specific sera used is supposed to be 1 in 400. It is proposed to test the cocci against them in a dilution of 1 in 50, 1 in 100, 1 in 200, and 1 in 400 respectively.

Serum Dilution.—(a) Normal serum (control). 0.2 cubic centimetre of normal serum is placed in a test tube by means of the small 0.5 cubic centimetre pipette and 4.8 cubic centimetres of saline added. From the 5 cubic centimetres of 1 in 25 dilution of normal serum thus obtained, $\frac{1}{2}$ cubic centimetre amounts are distributed in the first left-hand vertical row of five tubes, and the three single tubes below them.

(b) Agglutinating serum for Type I meningococcus: A 1 in 25 dilution is made of this serum in the same way as in the case of the normal serum, but as more of it will be required in order to furnish the larger number of dilutions necessary, 0.3 cubic centimetre of this serum is taken in the first place and diluted with 7.2 cubic centimetres of saline; $\frac{1}{2}$ cubic centimetre amounts of this 1 in 25 dilution are then run into the six tubes of the first left-hand vertical row of Type I block (amber). In order to convert the remainder of this dilution in the test tube into a 1 in 50 dilution, 4.5 cubic centimetres of saline are added to it, and $\frac{1}{2}$ cubic centimetre amounts of this are then distributed in the second vertical row of six tubes. The procedure is repeated in the same way for the next two rows, but as the volume of the dilution that is left in the tube steadily increases it is advisable to reject some of it after row two, so that the quantity can be easily contained in a test tube of ordinary size, when diluted with an equal volume of saline. As the result of this series of dilutions, the four vertical rows of block 1 contain $\frac{1}{2}$ cubic centimetre amounts of Type I serum in dilutions of 1 in 25, 50, 100 and 200 respectively.

The procedure is then repeated with the agglutinating sera for meningococcus Types II and III, and successive dilutions of these distributed as before in $\frac{1}{2}$ -cubic-centimetre amounts in the tubes of blocks two (white) and three (blue). All the tubes have now a dilution of the required serum in half the final dilution decided upon.

The next step is to fill in from the standardized suspension bottles $\frac{1}{2}$ -cubic-centimetre amounts of each of these respectively into each tube in the horizontal rows with the five-cubic-centimetre pipette including the control tubes in the left-hand row containing normal serum. Finally, four $\frac{1}{2}$ -cubic-centimetre amounts of each of the control cocci homologous to the specific sera are filled into groups of four tubes in the lowest horizontal row of the stand. All the tubes are then plugged and incubated for twenty-four hours at 55° C.

Results.—In reading off the results it is advisable always to examine the tubes in the same order. Thus the controls of each coccus with normal serum in the

left-hand vertical row and three bottom single tubes are examined first, and then the controls of homologous cocci in the lowest horizontal row. The former being negative and the latter positive; the degree of agglutination of each coccus to the three specific sera respectively is next noted. It is convenient to have one's own signs for indicating the degree of agglutination. Thus "⊕" signifies absolutely clear fluid and the cocci clumped in flocculi at the bottom of the tube; "+" indicates obvious flocculi of fair size floating in the fluid, but the latter still somewhat turbid; "(+)" indicates turbid fluid with small flocculi only.

If the controls are not satisfactory no inference can be drawn. Thus unless agglutination of the control type coccus takes place with its corresponding anti-serum, there is no guarantee that the specific agglutinin is active. Similarly, unless the controls with normal serum are negative, the results with specific sera are of no account. It should be remembered that certain examples of *M. flavus* agglutinate with normal serum.

The titre of 1:400 is chosen for this experiment because it is a good average one. Some sera go higher, in which case the primary dilutions would, of course, be correspondingly increased.

Group Agglutinins.—It has been found that certain Gram-negative cocci of the naso-pharynx other than meningococci may agglutinate with these anti-meningococcus sera in their low dilutions. Such of these cocci, however, as have been met with do not agglutinate beyond the first, or the two lowest, dilutions; they have been found by absorption tests not to absorb the specific agglutinin from these univalent sera.

In order to avoid confusion from the action of group agglutinins, this differentiation of meningococci occurring in the cerebrospinal fluid of cases in the present outbreak into three main types has been effected by controlling the result of the agglutination test by an after-test to determine whether the specific agglutinin has been absorbed or not. Strictly speaking, the agglutination test furnishes presumptive evidence only; complete identification is not established until it has been proved that the specific agglutinin of the type meningococcus has been absorbed by the coccus of test. For practical purposes, however, the agglutination test appears to be sufficient; provided that it is conducted quantitatively, and the titre of the coccus of test compares with that of a control of the homologous coccus with the same serum at the same time. It should be mentioned that Types I and III appear to be closely related, meningococci of Type I frequently, but not always, showing some agglutination with Type III anti-serum.

General Remarks.—It will be clear from the above that when cerebrospinal fever breaks out in a district, it is most important to test the meningococcus occurring in the cerebrospinal fluid of the case or cases in order to determine its type. The information obtained in this way is a guide both to the correct specific serum for therapeutic use, and also to the type of meningococcus to be specially looked for in the nasopharynx of contacts. It would seem desirable to keep a watch in the same way on meningococci occurring in the cerebrospinal fluid of any further cases in order to see if the predominant type should alter; in which case a corresponding modification would be necessary in the defensive measures. Again, it will be of great interest to know whether more than one type of meningococcus is to be found at the same time in the cerebrospinal fluid of a case of

cerebrospinal fever; and also whether the same type occurs in the nasopharynx as is present in the cerebrospinal fluid of the patient.

The Medical Research Committee have arranged to supply, free of cost to medical officers specially appointed for the study and treatment of military cases of cerebrospinal fever, sets of the necessary outfit, with standard agglutinating serum and standardized homologous agglutinable suspensions of each of the three types respectively, as part of the assistance they have given to the War Office in the scientific study of measures for the treatment and control of the disease.

All applications for the outfit, with standard sera and suspensions, should be addressed to the

CENTRAL C.F.S. LABORATORY,
ROYAL ARMY MEDICAL COLLEGE,
GROSVENOR ROAD, LONDON, S.W.

It will be observed that owing to its rarity up to that time, Type 4 was at first not included in the outfit. A few cultures of meningococcus were received about this period from sporadic cases of meningitis among children, and could not then be identified. In view of later experience, and especially of Captain Tulloch's research, it is highly probable that at any rate some of these were really specimens of Type 2. To provide for the possible appearance of new types, or of types not previously identified, officers in charge of District Laboratories were asked to forward to the Central Laboratory any meningococci from cerebrospinal fluid that refused to agglutinate with the sera sent out.

During the following months the disease recrudesced and the agglutination test was found to furnish much valuable information. The cocci received as not agglutinating with the sera were comparatively few, and the majority of them proved to be specimens of Type 4. It also was found that in the case of Type 2 some sera were better than others, owing to the tendency of certain specimens of this type to become "sub-typical" in culture. In order to exclude error from this cause, freshly isolated specimens of Type 2 were used to make the antiserum of this type. In all cases, only a single meningococcus has been used at a time, and throughout only meningococci actually isolated from the cerebrospinal fluid of cases, and proved by the absorption test, have been employed in the preparation of agglutinating serum.

Owing to the appearance of Type 4 in a proportion of the cases during an outbreak in a large garrison in the early part of 1916, this coccus and its antiserum were added to the outfit from that date. With one exception, however, no further outbreaks have come to notice in which this particular type of meningococcus has been at all frequent.

Now that an accurate method of identifying the meningococcus in the nasopharynx was available, the following memorandum was sent round to District Laboratories with the object of obtaining further information concerning the general distribution among the military population of meningococci of known epidemiological significance.

MEMORANDUM.

(1) MODE OF SPREAD OF CEREBROSPINAL FEVER. EXAMINATION OF CONTROLS.

As part of the investigation of factors governing the spread of cerebrospinal fever, it is very desirable that, as far as possible, opportunity should be taken of making control observations with a view to ascertaining what proportion of non-contacts harbour the meningococcus in their nasopharynx.

It is suggested that, other things being equal, it would be more useful to examine for this purpose small groups of men from a large number of units, rather than a large number of men from the same unit.

Before such investigations are undertaken, a particularly careful inquiry should be made to ascertain whether or no there has been any possibility of recent contact with a case of cerebrospinal fever, or with a carrier from such a case.

No Gram-negative coccus should be accepted as the meningococcus for the present purpose, unless it fails to agglutinate with normal serum and at the same time agglutinates to approximately the same titre as the homologous meningococcus with one or other of the anti-meningococcus sera supplied.

In positive cases it will also be valuable to know (1) the relative abundance of the meningococcus in the nasopharyngeal mucus of the person carrying it, and (2) the duration of such carrying.

(2) DEFINITION OF THE RELATION BETWEEN OUTBREAKS OF INFLUENZAL CATARRH AND CEREBROSPINAL FEVER.

In some camps severe outbreaks of coughs and colds have occurred. It is desirable to make observations on the bacteriology of these cases both from the point of view of the presence or absence of the meningococcus, and also for the purpose of determining what are the prevalent bacteria in these cases of catarrh.

CENTRAL C.S.F. LABORATORY,

ROYAL ARMY MEDICAL COLLEGE, S.W.

February 16, 1916.

The continuous observations initiated in the following autumn by Captain Flack at a large training depot, and continued so ably by Captain Glover, are described in a paper by the latter in the present number.

VI.—RESULT OF PRACTICAL APPLICATION OF THE AGGLUTINATION TEST FOR IDENTIFICATION OF THE MENINGOCOCCUS.

The report of Captain Martin Flack on cerebrospinal fever in the London district during 1916 demonstrates in a convincing manner the value of the agglutination test in actual practice, both for detecting cases of the disease, and also for identifying carriers. With regard to cases he found (1) that not more than a single type of meningococcus could be obtained from the cerebrospinal fluid of a patient; (2) on examination of the nasopharynx of the patient he confirmed the later observation of von Lingelsheim as to the constant presence of the meningococcus there at the onset of the disease, and he showed further that this meningococcus in the nasopharynx was always of the same type as that present in the cerebrospinal fluid of the

patient when this was positive. A similar observation as to the identity of type between the meningococcus in the nasopharynx and cerebrospinal fluid of the same case has also been reported by Major F. W. Andrewes. This constant presence of the meningococcus was found by Captain Flack to have a direct clinical application in facilitating a correct diagnosis of cerebrospinal fever in the very cases where help of this kind was most needed; namely, in cases where the symptoms of the patient were atypical, or where the cerebrospinal fluid failed to yield a growth of the meningococcus. The importance of early diagnosis cannot be over-emphasized from the point of view of successful serum treatment. Captain Flack also found that the same type of meningococcus was most prevalent both in cases and in carriers during the period that he was in charge of the London District C.S.F. Laboratory. Another observation made by him and also by Captain Tulloch was that, like the cases, chronic carriers are remarkably monotypical, in the sense that the great majority of them carry one and the same type of meningococcus throughout the whole period of their carrying.

A good opportunity for comparing the types of meningococcus prevalent in cases and in carriers respectively occurred during an outbreak of cerebrospinal fever in a large garrison during 1916.

Meningococci from the cerebrospinal fluid of thirteen cases of the disease were examined at the Central Laboratory with the following results:—

Type	..	1	..	2	..	4
Specimens	..	3	..	5	..	5

A very large number of men in this garrison had been swabbed by Captain R. R. Armstrong, and amongst them he found a proportion who harboured suspicious Gram-negative cocci in their nasopharynx. From 193 of these men Captain Tulloch obtained cultures of Gram-negative cocci that agglutinated with one or other of the univalent agglutinating sera. The distribution of types among these men was as follows:—

Type	..	1	..	2	..	4
Specimens	..	30	..	72	..	71

The correspondence of types in cases and carriers is remarkable. It may be added that the identification of types in the cases and carriers was made independently, and that it was not until Captain Tulloch came to write up his report that this closeness of the grouping in the two series was noticed.

For the last two years monotypical agglutinating sera have been in routine use at the Central Laboratory and in district laboratories for detecting the meningococcus both in cases and in carriers with satisfactory results, and it is hoped that some of the reports of district laboratories bearing upon this matter will be published. Meningococci isolated from troops coming from England, Scotland, Wales, Ireland, France, Gallipoli, Australia, New Zealand, Canada and South Africa have been submitted to examination, and in the vast majority of instances relegated with ease to one or other of the four types. When preparing a new circular for issue

with the agglutinating outfit during August of the present year, it was found on inspecting the records that during the past two years meningococci from the cerebrospinal fluid of over 300 cases of the disease had been tested in the Central Laboratory alone, with the result that approximately 98 per cent of them had been identified by the agglutination test with one or other of the four types. The relative abundance of individual meningococci has varied from time to time, but on the whole their relative frequency may be put roughly as follows:—

Type	..	1	..	2	..	3	..	4
Frequency	..	40 per cent	..	45 per cent	..	10 per cent	..	5 per cent

Thus 85 per cent of the cases have been due either to Type 1 or to Type 2, and the experience of 1915 has been confirmed throughout each of the two years that have elapsed since the types of meningococcus at work in the present outbreak were defined.

VII.—THE RESULT OF INVESTIGATION OF FURTHER SPECIMENS OF THE MENINGOCOCCUS BY THE ABSORPTION TEST.

With a view to checking previous results, and also to obtaining further information concerning the types of meningococcus occurring in cases of cerebrospinal fever, Captain W. J. Tulloch continued the investigation of these organisms by means of the absorption test. In this way he examined with scrupulous care 100 more specimens of meningococci from the cerebrospinal fluid of cases. Captain Tulloch's paper on this subject has been published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for July, 1917. His investigation not only confirmed previous results, but also brought out a new and very important point—namely, that in the case of meningococci belonging to Type 2, previously the most difficult of all to classify by the absorption test, no less than three distinct sub-groups are distinguishable. This sub-grouping in the case of Type 2, however, does not interfere with the practical utility of the agglutination test when identifying Type 2, for Captain Tulloch has shown that by preparing a rabbit with a sufficiently typical meningococcus of this type, an agglutinating serum can be prepared that includes cocci of all its three sub-groups by the agglutination test. Captain Tulloch's research has thus been of the greatest value, not only in consolidating information upon this most important matter, but also in improving the accuracy of the method in its practical application.

Inter-relation of the Types.

Are the four serological types of the meningococcus merely temporary variants of one and the same micro-organism, or are they pathogenically distinct members of the same group, somewhat after the manner of *B. typhosus* and *B. paratyphosus* A and B?

The answer to this question given by the absorption test is undoubtedly to the effect that the types are not temporary variants, but are distinct and

stable entities. In order to throw further light upon the matter the following experiments have been carried out.

Super-imposition Tests.

On considering this problem of the relationship of the types of meningococcus to one another, it appeared that in addition to the information afforded by the absorption test, further information might be gained by comparing the effect of injecting the meningococcus of another type into a rabbit already elaborating agglutinin in response to previous stimulation with a given type of meningococcus. If the second type of meningococcus were only a temporary variant of one and the same micro-organism as the first, then the effect of superimposing it in this way should be merely to stimulate the production of the agglutinin which the animal was already in course of elaborating. If, on the other hand, the type secondarily injected were a specifically different micro-organism, then the first agglutinin, so far from being increased, would exhibit its normal decline; and a new agglutinin specific for the new antigen would make its appearance in the rabbit's blood.

These experiments have been described elsewhere. In the first place five young rabbits were all injected with Type 1, and when on the sixth day their blood showed a titre of from 1 in 300 to 1 in 600 for this coccus, four of the rabbits received a second injection. Thus Rabbit A was not interfered with, Rabbit B received a second dose of Type 1, Rabbit C received a dose of Type 2, Rabbit D of Type 3, and Rabbit E of Type 4. The result was that in the case of the rabbit that received the second dose of Type 1 the original agglutinin was increased, whereas in the case of each of the other three rabbits a new agglutinin specific for the new type, and previously absent from the rabbit's blood, made its appearance. Further experiments in which Type 2 was first injected, and Types 3 and 4 superimposed, showed that in such cases also, while the agglutinin for the primary coccus declined, new agglutinins appeared in the rabbits' blood specific for the cocci of Types 3 and 4 respectively in a precisely similar fashion as had been observed in the first experiment. Finally, the superimposition of Type 4 in a rabbit already elaborating agglutinin to Type 3 resulted in the same way in the birth of a new agglutinin specific for Type 4 in the rabbit's blood.

These superimposition experiments, therefore, confirm the result of the absorption tests in a very definite manner, and afford striking evidence of the serological specificity of the different types.

Immunity Tests.

In order to define the protective values of prophylactic inoculation of individual types of meningococcus, a group of rabbits was prepared against Type 1, another against Type 2, and other groups against Types 3 and 4 respectively. After each animal had received a number of doses at weekly intervals, and showed a good yield of homologous agglutinin in its blood,

one rabbit of each group and a control normal rabbit were saturated with Type 1, another set with Type 2, and the same repeated with Types 3 and 4. As a result it was found that in the case of Types 2, 3 and 4, the homologous rabbit survived, while the other rabbits succumbed. The protection afforded by prophylactic inoculation, therefore, with these types was univalent. In the case of Type 1, on the other hand, the homologous rabbit, in spite of its previous treatment, was no more protected against Type 1 coccus than a control normal rabbit. The whole experiment was repeated with new specimens of the type cocci, and a similar result obtained.

So far as they go, therefore, these immunity tests indicate that in the case of Types 2, 3 and 4, the protection is mainly univalent. In the case of Type 1, it is clearly far more difficult to protect a rabbit than in the case of the others, a difficulty probably due in great part to the particularly potent endotoxin of this type.

It may be here mentioned that Kennedy and Worster Drought have drawn attention to a point observed by them with regard to the relative intensity of the illness in cases of cerebrospinal fever, according as they are infected by one or another type of meningococcus. In their experience cases due to Type 1 are far more severe and fatal than most of the cases due to Type 2. This clinical experience appears to be in accord with what has been observed elsewhere, and is on a par with the result of the protective tests described above.

It may be of interest to mention here that a particular therapeutic serum of which much use was made during the early stage of the outbreak in 1915 with disappointing results, was tested at the time against meningococci from the cerebrospinal fluid of the cases, and found not to agglutinate them. The coccus then most prevalent was Type 1. A sample of this serum was recently submitted for examination again and tested against the four types with the result that while agglutinins for 1 and 2 were practically nil, agglutinins for 3 and 4 were found to be abundant. The inference that the horse furnishing the serum had been prepared against the wrong types is difficult to avoid. The interest of this observation, however, is not limited to the negative virtues of the serum. The only medical officer who has obtained good results with this serum (and whose request for more led to my examining the sample) is one in whose district Type 4 cases have certainly been identified, and also some cases in which the infecting coccus could not be identified with Type 1 by absorption tests and almost certainly was an example of Type 3.

The following instance of the value of monotypical serum which occurred during the last season is only a single case, but it is worthy of attention. A young woman of good physique was seized with cerebrospinal fever, and as the serum which she received did her no good, the civilian medical officer in charge sent an urgent request for another brand. Having some Rockefeller serum kindly sent to me by Dr. Flexner for trial,

I forwarded some with the request that a sample of the patient's cerebrospinal fluid should be submitted, so that the type of meningococcus present could be determined. This material shortly arrived, and the coccus was found to be a specimen of Type 3. The Rockefeller serum sent for trial, though strong in agglutinin for Types 1 and 2, showed very little for 3 and 4. I was not surprised, therefore, to hear that the Rockefeller had been no more successful than the other. Now we had a few bottles of Type 3 serum made by Dr. Stanley Griffith for us a year previously when we were trying to get agglutinating serum from horses for identification of types of meningococcus. The horse serum proved useless for the purpose then in view because, although it had a high titre for Type 3, co-agglutinins were abundant in the lower dilutions. This serum was the patient's only hope, and it was therefore sent for trial. The effect, it is pleasing to report, was extremely satisfactory, the patient making a rapid recovery forthwith. This monotypical serum was also used on some other Type 3 cases about the same time with satisfactory result, although the routine serum had failed to benefit them.

Measures are being taken at the present time to prepare monotypical sera on a larger scale for more extensive trial in the treatment of cases of cerebrospinal fever.

CONCLUSION.

The agglutination test controlled by the absorption test, therefore, has proved practically of the greatest possible use in dealing with the outbreak of cerebrospinal fever among the military forces. By its means a serious error has been eliminated when identifying carriers of the meningococcus; diagnosis has been facilitated, particularly in those cases where it was most needed; and meningococci occurring in the cerebrospinal fluid of the cases have been differentiated into four separate types which breed true, and while closely similar in characters of minor importance, are clearly distinguished from each other by the reaction to them of the tissues of the living animal.

The full results of this differentiation have still to be reaped, but a severe practical trial of the agglutination test during the past two years on a scale that is without precedent in this country has demonstrated beyond all reasonable doubt that this method constitutes at the present time by far the most valuable of all known methods of identifying the meningococcus.

APPENDIX.

NOTE ON SOME RECENT OBSERVATIONS BY OTHER WORKERS WITH REGARD TO THE CLASSIFICATION OF MENINGOCOCCI.

During the early stages of the present outbreak, Arkwright and Ellis observed independently that meningococci occurring in the cases fell into two distinct groups. Both observers relied upon simple agglutination.

Prior to the present outbreak, the work of Arkwright in this country

and of Dopter in France had paved the way for the present differentiation. Arkwright made a collection of meningococci isolated from cases and tested their agglutinative characters. By this means he obtained evidence of the presence of several different kinds of them, and he noticed that diversity was more marked in cases of meningococci from sporadic than in those from epidemic cases. The *Comptes Rendus* from 1909 to 1914 contain a set of papers by Dopter that are of special interest, because they show the stages by which, from an entirely independent standpoint, this distinguished medical officer of the French Army arrived at a conclusion very similar to that reached by us as the result of a systematic serological analysis by the agglutination + absorption test of meningococci from military cases during the present outbreak. In the first place his researches on the Gram-negative cocci from the nasopharynx of soldiers led to the identification of a group of cocci indistinguishable from the meningococcus in morphological, cultural and fermentative respects, but distinct in agglutinative characters and in the absorption test. To this group he gave the name "parameningococcus." On proceeding to examine meningococci from the cerebrospinal fluid of cases of cerebrospinal fever in the same way, he found that serologically two different kinds could be distinguished. The first he regarded as the meningococcus, the other he called parameningococcus. The investigation of meningococci from the cerebrospinal fluid of further cases led to the definition in the same way of still further parameningococci, until by May, 1914, he had distinguished no less than three parameningococci, all serologically distinct from the meningococcus and from one another.

M. Nicholle, of the Department of Serotherapy of the Pasteur Institute, has received specimens of our four types of meningococcus, and regards Types 1 and 3 as belonging to the meningococcus group, and 2 and 4 to the group of parameningococcus. I understand that he has not applied the absorption test: without this, of course, the action of co-agglutinins cannot be excluded.

In a volume recently issued by the Medical Department of the Local Government Board, certain criticisms are made of the procedure with reference to identification of meningococcus summarized in the present paper, and an attempt is made to throw doubt upon the value of the absorption test. The work thus criticized, however, is its own witness; and the demonstrated success of the quadrivalent agglutination test in practice during the last two years for identifying the meningococcus both in cases and in carriers among the Forces is sufficient to dispel these doubts based to a large extent upon theoretical considerations, which are extremely insecure from the scientific point of view.

Definition of the relationship between pharyngococci and meningococci is a matter of research rather than of philosophy; research, moreover, of a distinctly arduous character. The final criterion so far has been the capacity of a given coccus to combine with a specific agglutinin *in vitro*.

Now in its practical application to Gram-negative cocci the absorption test upon which the final decision rests is work demanding a very high degree of dexterity that can only be acquired by continuous and persevering effort. The test is a process of balancing, dependent upon a series of very accurate measurements and quantitative adjustments: and even minute errors may mar or upset the result. In our experience at the Central Laboratory it requires at least six weeks' hard work before even a trained bacteriologist with considerable serological experience can sufficiently master the technique to obtain consistently satisfactory results in absorption tests of these delicate micro-organisms. Similarly, when he goes for a holiday—even for a week—it requires at least another week's work before the necessary unconscious manipulative dexterity returns. After that degree of skill is reached, irregular results are far less frequent than before. Granted that this factor of technique is equal in both sets of workers, the following sources of fallacy merit attention.

(1) When we were working out the meningococci of the present outbreak by the absorption test, the urgency of reaching a decision in the shortest possible time saved us from a pitfall into which the Local Government Board workers may have fallen. In addition to the quality of the antigen, a factor of first-rate importance in the absorption of agglutinin test is the quality of the agglutinin used. Now it was observed at an early stage of the investigation that our sharpest-cut results with the absorption test were obtained with the "first-born" agglutinin: that is to say, the agglutinin that appears first in the rabbit's blood in response to injection. While strictly specific, this agglutinin is in our experience more ready to unite with the antigen employed than older agglutinin. The agglutinating serum used by us throughout came from young rabbits (1,000 grammes), which had all received intensive treatment. Most of them had not been under preparation for more than ten days before their blood was collected. The serum from rabbits immunized over several months is not in our experience the best for absorption tests.

A concrete instance may be given to illustrate the importance of the quality of the agglutinin in this test. During 1915, a certain univalent agglutinating serum prepared against Type 1—which, as a rule, is the easiest to work with—had been employed on a number of occasions for absorption tests, and was promptly returned to the cold store when not in use. After several months, however, the agglutinin in this serum—while still agglutinating its type cocci practically as well as before—was found to have lost much of its power of combining with the specific antigen, and the serum had to be replaced by another one freshly prepared. This gave the same sharp-cut results that we had been accustomed to.

In this relation it may be mentioned that in our experience horses' serum is not suitable for absorption tests with Gram-negative cocci. For some reason, the agglutinin in the serum of horses appears to be less ready to combine with these organisms, *in vitro*, than the agglutinin made by the

young rabbit. It should be added, however, that our experience in this matter has been limited to specimens of antimeningococcus serum supplied for therapeutic use, and that these specimens of horse serum were of some standing.

(2) Another conceivable reason why the results of these workers are not in harmony with our own is the possibility that the difficulties of Type 2 (perhaps the most widely diffused type of all), which Captain Tulloch succeeded in overcoming by an arduous research, did not yield to their attack.

(3) A third possible reason—and, in view of Arkwright's observations on the matter, this is the most probable explanation of all—is that serological diversity amongst meningococci from cases in children of the civil population—from whom much of their case material appears to have been derived—is greater than in that of meningococci obtained from soldiers during an epidemic. My present experience of them, though small, has certainly led me to suspect that meningococci from sporadic cases in children are serologically less uniform, and therefore more difficult to define than those obtained from military cases during an outbreak of cerebrospinal fever.

That the difficulties, however, of a complete classification of meningococci are by no means insuperable, is indicated by the following facts:—

(1) In a letter received from him in July last, Lieutenant-Colonel C. J. Martin wrote: "I think I told you that when I was at home last winter we tested out upwards of 100 strains which had been kept going at the Lister, and found that all but one would fall comfortably into one or other of the four groups."

(2) Captain E. Douglas Pullon, Government Bacteriologist at Capetown, investigated a series of meningococci obtained from cases of cerebrospinal fever in South Africa, and having differentiated them with agglutinating sera prepared by himself, forwarded suspensions of these cocci to the Central Laboratory for examination. The suspensions arrived a few weeks ago and were tested against the four univalent sera in the routine manner, with the result that of sixteen meningococci from cerebrospinal fluid nine were specimens of Type 1, five were specimens of Type 2, and two were specimens of Type 3. No example of Type 4 was found. On reference to the enclosure in Captain Pullon's letter giving his own results, it was seen that the classification of these cerebrospinal fluid strains effected by our sera was identical with that made by him; the only difference being that his Group A was our Type 3, his Group B, Type 2, and his Group C, Type 1. There is good reason to believe, therefore, that a limit obtains with regard to the diversity of meningococci; and that at any rate the most important pathogenic members of the group have now been defined.

THE CEREBROSPINAL FEVER EPIDEMIC OF 1917 AT "X" DEPOT.

BY

CAPTAIN J. A. GLOVER,
Royal Army Medical Corps.

" its (i.e., the then undiscovered meningococcus) selective property for the meninges must certainly be greatly influenced by the insanitary atmosphere that always hovers over large collections of men, by the fatigue, and by the depression of rigid discipline, and by the impaired vitality ensuing from the first entry into a monotonous existence."—*Lieut.-Colonel Dimmock, I.M.S., written in 1884 on an epidemic of cerebro-spinal fever in India.*

I.—GENERAL DESCRIPTION.

SET 600 feet above sea level, on the highest part of a chalk plateau, and surrounded by open common lands, the depot is a pleasant spot in summer.

Unprotected in any way from the east, or indeed from any other wind, there are few bleaker spots in the South of England in the frosts and blizzards of such a winter as that of 1917. Small wonder then if recruit and returned Expeditionary man alike felt justified when, in draughty huts, they closed all windows as tightly as the contractors would permit, and enjoyed the very closeness of their overcrowded atmosphere.

It is an interesting fact that if the beds of a heavily infected hut be charted, the carriers lie usually thickest round the stove, no doubt owing to the nightly gathering round the only warm and certainly the stuffiest portion of the hut.

In peace time the depot is housed entirely in its permanent barrack-rooms and has a normal population of some 800 men.

Since war began, its accommodation has been increased to fivefold by huts, and the population has sometimes exceeded sevenfold its peace population.

The depot receives straight from civil life the recruits of five infantry regiments, hereinafter called A, B, C, D, E, in order of both seniority and strength.

These recruits it trains for three months intensively, and they are then drafted to the respective Reserve battalions of the five regiments, in various places.

Most of the population is therefore floating; it abides three months, and passes.

There is, however, a permanent staff of instructors, and two trained soldiers are in each barrack-room or hut. This arrangement may have an important bearing on the transmission of the infection from season to season.

24 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

II.—PREVIOUS OUTBREAKS OF THE DISEASE.

Cerebrospinal fever first appeared at the depot in the early part of 1915, following a period of severe overcrowding due to the recruiting situation of that time.

Nineteen cases occurred at the depot, with eleven deaths, followed by ten cases with six deaths in the various barracks of the Reserve battalions and in a camp fed by the depot.

No differentiation of types of the meningococci in these cases was made, as Lieutenant-Colonel Gordon's work was not then published.

In February, 1916 (Captain M. Flack, Special Report, Medical Research Committee No. 3), cerebrospinal fever reappeared at the depot, and between February and April seven cases occurred. These were all due to the Type II meningococcus. The patients all recovered.

From the occurrence of the first case, a very thorough investigation not only of contacts of the cases, but also of contacts of the positive contacts, was carried out by Captain Flack.

This revealed a *contact* carrier rate of 21 per cent in February (113 men examined contacts of 1 case), of 9 per cent in March (219 men contacts of 4 cases), of 20·5 per cent in April (39 contacts of 1 case) and of 6 per cent in May (60 contacts of 1 case).

In every case and in every carrier meningococcus Type II was found.

The undisputed predominance of Type II in cases and contacts is most striking.

All positive contacts thus discovered were forthwith isolated.

No cases occurred during this season in the Reserve battalions.

III.—BEFORE THE EPIDEMIC OF 1917—THE AUTUMN OF 1916.

In August a large non-contact sample was taken by Captain Flack by swabbing 121 men who had been three months in the depot. He found a carrier rate of ten per cent, an unexpectedly high figure, especially for the time of year.

He therefore decided to keep a continuous watch upon the carrier rate by means of large weekly swabbings, as he anticipated a return of the disease in the following winter.

The aggregate swabbings in September showed a carrier rate of 5 per cent, in October 6 per cent and in November 4·6 per cent. So far all seemed well.

The depot was, however, rapidly filling up, as a result of the operation of the National Service Acts, and in the first week of November was for the first time above its "mobilization" accommodation.

On December 4, a number of Aylwin huts were occupied for the first time. On December 9 the overcrowding was at its zenith, over a thousand men more than the ordinary "mobilization" strength and 600 more than

the "extra mobilization" strength being accommodated in drill sheds, etc., as well as in the Aylwin huts.

On December 11 an epidemic of German measles was fairly established, and from this date carriers, detected by sampling, were isolated in huts in the depot, instead of being sent to the carrier centre, which was full.

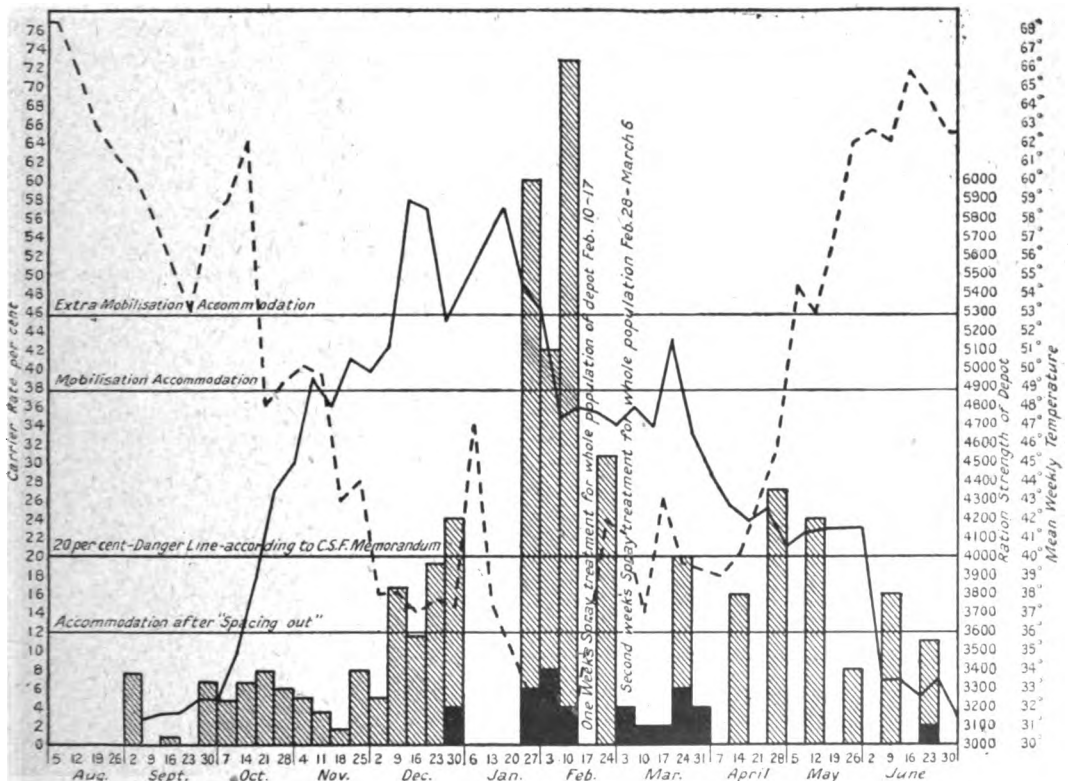
The carrier rate, which had kept beautifully low during November (5 per cent on November 29) now commenced to rise in ominous fashion: on December 6 it was nearly 17 per cent; on the 21st, 19 per cent, just under the 20 per cent danger line, as laid down in the War Office Memorandum (24/Gen. No./3595 (A.M.D.-2) March, 1917).

The carrier rates are shown upon the Chart A.

CHART A.
CEREBROSPINAL FEVER, "X" DEPOT.
1917 EPIDEMIC.

Chart showing percentage carrier rate—shaded columns—in relation to—

- (1) Incidence of cases. ■ = 1 case.
- (2) Ration strength of depot—black line, thus: —————
- (3) Mean weekly temperature—dotted line, thus: - - - - -



26 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

Details of the non-contact samples before the epidemic are seen below.

PERIOD BEFORE THE COMMENCEMENT OF THE EPIDEMIC.

Date	Non-contact sample or contact	Number swabbed	Number positive	Carrier rate per cent	Types			
					I	II	III	IV
September 7 ..	Sample	127	10	8	3	3	..	4
" 14 ..	"	123	1	0.75	..	1	..	..
" 25 ..	"	119	7	6	..	5	2	..
October 2 ..	"	120	5	4	1	3	1	..
" 9 ..	"	139	9	6.5	4	4	1	..
" 16 ..	"	118	9	7.5	4	4	1	..
" 23 ..	"	117	7	6	2	4	1	..
" 30 ..	"	121	6	5	..	3	3	..
November 5 ..	"	90	3	3.25	2	..	1	..
" 13 ..	"	115	2	1.75	2	..	..	..
" 22 ..	"	113	9	8	3	1	5	..
" 29 ..	"	120	6	5	2	3	1	..
December 6 ..	"	120	20	16.75	2	17	..	1
" 13 ..	"	119	14	12	12	2	..	..
" 21 ..	"	125	24	19.25	3	20	1	..
" 29 ..	"	91	10	11	1	9	..	..

IV.—THE EPIDEMIC.

Just at the end of the year, all the requisite factors for an epidemic of cerebrospinal fever were present: cold weather, severe overcrowding, a high carrier rate, and a population rendered susceptible by youth, by strange surroundings and methods of life, and by the depressing effects of nostalgia, combined with the malaise of anti-typhoid inoculations and vaccination, performed before acclimatization to their new circumstances was established.

The first case was diagnosed on December 29, and was almost immediately followed by one other. The contacts (73) of these two cases showed carrier rates of twenty-three and twenty-seven per cent respectively. Both were due to Type II meningococcus, seventeen out of twenty positive contacts carrying the same type.

No further cases occurred for three weeks, and owing to the unfortunate illness of Captain Flack no samples of non-contacts were taken during this period (Captain W. Allan then carried on the work for some weeks until he also fell ill; his observations are recorded from January 24 to February 19, inclusive).

During the same three weeks the Aylwin huts, which had been leaking badly, were given up, and 500 men were sent away from the depot to ease the overcrowding. Influenza of a mild type and bronchial catarrhs became increasingly prevalent.

Between January 24 and February 2, seven cases of cerebrospinal fever occurred in succession, three of them being fulminating cases, the patients dying within twenty-four hours of onset.

Of these cases, 185 contacts were swabbed, showing a carrier rate of forty-six per cent.

The first of these cases was due to Type I meningococcus, the rest were all due to Type II.

The contacts of the first case showed a percentage carrier rate of forty-three, those of the second reached the appalling rate of seventy-one per cent, the hut containing thirty-two men, one of whom was the patient (Type II), ten of whom were carriers of Type I, eleven of Type II, one of Type III. Six of the nine remaining had organisms resembling meningococci which failed to agglutinate with the standard sera; only three were above suspicion.

A sample of *non-contacts* taken on February 5 showed the even higher percentage of 72·5 per cent, the trained soldiers being almost as heavily infected as the recruits. The period of this group of cases exactly coincides with the great frost—the severest weather experienced in England since 1895.

It was now obvious that a severe epidemic was threatened, and the question of swabbing the whole garrison and isolating all carriers was discussed, and negatived on account of the magnitude of the work and the practical certainty that half the population were carrying.

Instead, the following measures were taken: parades were shortened, inoculation and vaccination stopped, men were spread out as much as possible (numbers were now slightly below “mobilization” scale of accommodation), a certain number of windows in each hut and room were fixed open, and the crowding of Y.M.C.A.’s, etc., was limited.

It was also determined to subject the entire population to treatment with Levick steam sprays, using one per cent zinc sulphate dissolved in 0·85 per cent saline. Four huts were adapted, using eight Levick sprays, each hut having a small central portion partitioned off to form an inhaling chamber of some 1,800 cubic feet and containing two Levick sprays; the portions of the hut on either side served respectively as an antechamber to prevent loss of vapour, and as a cooling-off room. The latter was warmed by stoves, and the men remained in it seven minutes after being seven minutes in the inhaling chamber. Every man in the depot was thus treated for seven consecutive days.

After a two days’ interval the camp was systematically sampled.

RESULTS OF SAMPLE SWABBINGS AFTER ONE WEEK’S SPRAYING.

Date	Regiment	Number swabbed	Number positive	Percentage	Types			
					I	II	III	IV
19.2.17	A	50	15	30	0	14	0	1
19.2.17	B	50	11	22	1	10	0	0
22.2.17	C	50	12	24	2	9	0	1
22.2.17	D	50	18	36	8	8	0	2
24.2.17	E	50	21	42	4	17	0	0
	Total	250	77	30·8	15	58	0	4

Total number swabbed .. 250
 „ „ positive .. 77

28 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

February 19 to 24. Carrier rate (after spraying) 30·8 per cent.

The general carrier rate, therefore, had fallen from sixty per cent to 30·8 per cent. This was encouraging but still too high, and all the garrison were again submitted to a week's course of spraying, beginning February 28, 1917.

The general use of the steam spray was then discontinued and on March 7 only freshly-joined recruits were sprayed during their first week in the depot.

On March 22 another sampling was done, the result being :—

Date	Regiment	Number swabbed	Number positive	Percentage, carrier rate	Types			
					I	II	III	IV
22.3.17	B and C, 23 of each	46	9	20	5	4	0	0

The contacts of three cases swabbed upon the same day showed a percentage carrier rate of thirty-one.

The last two cases of the epidemic occurred on the same day, March 27, and in the same hut. This was the only occasion when any apparent connexion between patients occurred, but the population of this hut showed a carrier rate of only seven per cent, only two carriers of Type II being discovered, although all were twice examined on different days. This was in Regiment "C."

Nine cases occurred during March, making nineteen in all during the epidemic ; there was also one case in which the diagnosis was doubtful.

Of the undoubted cases, one only was due to meningococcus Type I, thirteen were due to Type II, and in five cases growth was not obtained, owing either to the death of the patient in the fulminating cases, or to the chilling of the specimen taken late at night in the cold, and on the long journey to the laboratory.

Cases were fairly evenly distributed amongst the regiments in proportion to their strength. "C," a Scottish regiment, had comparatively low carrier rates throughout, whilst "D," an Irish regiment, had high carrier rates and no cases at all.

One additional sporadic case (due to Type I) occurred on June 20.

V.—CONTACTS.

During the time of the general spraying, examination of the contacts of six cases was not made, as all were being treated, and in view of the high carrier rate prevailing throughout the depot, which was quarantined, isolation of these contacts was not practised.

Of the other fourteen cases (including the doubtful case) 426 contacts were examined, 145 of whom were found positive.

Seventy-five per cent of the positive contacts carried Type II meningococcus.

It is, however, both interesting and important to note, that if the total contact swabbings during the epidemic be compared with the total non-contact sample swabbings during the period of the epidemic, it will be found that the average carrier rate is the same, thirty-four per cent in each case. It will also be seen that these totals show nearly the same proportion of Type I and Type II.

The following table shows a summary of the three periods:—

SUMMARY OF PERIODS.

Period	Number swabbed	Number found positive	Carrier rate per cent	Types			
				I	II	III	IV
I. September to December 29. All non-contact	1,877	142	7.5	41	79	17	5
II. Period of epidemic, December 29 to March 31. Contacts	426	145	34	38	103	2	2
(Samples) non-contacts ..	336	115	34	31	78	2	4
III. Quarter after epidemic, April 1 to June 30	669	102	15.3	16	76	9	1
Totals September to June 30	8,308	504	15.2	126	336	30	12

DETAILS OF ALL EXAMINATIONS DURING THE EPIDEMIC PERIOD.

Date	Description	Number swabbed	Number positive	Carrier rate per cent	Types				Percentage carrying Gram-negative cocci failing to agglutinate
					I	II	III	IV	
Dec. 29	Contacts with a Type II case	30	7	23	—	5	1	1	47
Jan. 4	" " " II "	44	13	27	1	12	—	—	41
" 24	" " " I "	30	13	43	2	11	—	—	40.5
" 26	" " " II "	31	22	71	10	11	1	—	19.5
" 29	" " " II "	28	14	50	4	10	—	—	25
" 31	Contacts with a case type unknown	26	6	23	—	6	—	—	73
Feb. 2	Contacts with a Type II case	32	10	31.25	5	5	—	—	46.75
" 6	" " " II "	26	17	65	2	14	—	1	8
" 5	Non-contacts' sample ..	40	29	72.5	11	16	2	—	20
" 19	" " " " ..	250	77	30.75	15	58	—	4	5.25
March 17	Contacts with a Type II case	26	2	7.75	—	2	—	—	15.25
" 22	" " " II "	29	7	24	6	1	—	—	21
" 22	" " " II "	68	20	29.5	7	13	—	—	25
" 23	Contacts with a case type unknown	28	12	42.75	1	11	—	—	14.25
" 22	Non-contacts sample ..	46	9	20	5	4	—	—	32
" 28	Contacts with two Type II cases	28	2	7	—	2	—	—	7
Totals {	Contacts	426	145	34	38	103	2	2	—
	Non-contacts	336	115	34	31	78	2	4	—

30 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

(1) The autumn months prior to the occurrence of the first case on December 29.

(2) The epidemic period, December 29 to the end of March, both contact and non-contact.

(3) The quarter, April 1 to June 30, immediately following the epidemic, during which samples have been taken at regular intervals.

VI.—CARRIERS OF GRAM-NEGATIVE DIPLOCOCCI, WHICH ARE CULTURALLY INDISTINGUISHABLE FROM MENINGOCOCCI BUT WHICH FAIL TO AGGLUTINATE WITH ANY ONE OF THE FOUR STANDARD SERA.

A careful record has been kept of the percentage of men who carry organisms resembling on culture the meningococcus.

A comparison of the carrier rates of such men with the carrier rates of carriers of the serologically proved meningococcus shows some interesting points.

During the autumn period prior to the epidemic, the proportion of agglutinating organisms to non-agglutinating strains was quite small, usually about one-sixth, often less, and going as low as one-twentieth.

During the epidemic period, as the carrier rate rose, this proportion rose rapidly too, in non-contact samples equally with contacts, the agglutinable cocci now forming two-thirds, three-quarters, or even more of the whole.

This proportion was maintained for some time and sank much more slowly than it had risen. The proportion was not diminished by steam spray treatment, which greatly diminished the carrier rate of both. Thus, in the sample immediately before the treatment was commenced, of 40 men 37 (92·5 per cent) carried organisms resembling the meningococcus; of these 37, 29 (72·5 per cent of the whole) agglutinated (11, Type I; 16, Type II; 2, Type III), whilst 8 failed to agglutinate.

In the sample taken two days after the first week of spray treatment of 250 men, 91 (36·5 per cent) carried meningococcus-like organisms. In 77 (30·75 per cent) agglutination was positive (15, Type I; 58, Type II; 4, Type IV), whilst only 14 failed.

The steam spray treatment reduced the just and the unjust alike.

These observations seem to lead to one important practical point, cultural characteristics are a much more reliable guide with a high carrier-rate, and during an epidemic, than they are with a low carrier-rate in a non-epidemic period.

An increased proportion of those who carry agglutinable organisms to those who carry inagglutinable, though morphologically indistinguishable, diplococci, would also seem to furnish a danger signal, secondary in importance to the actual rise of the carrier rate.

The method of diffusion of these non-agglutinating organisms is probably exactly similar to that of the meningococcus.

Flavus agglutination has been treated throughout the Chart B and table as negative.

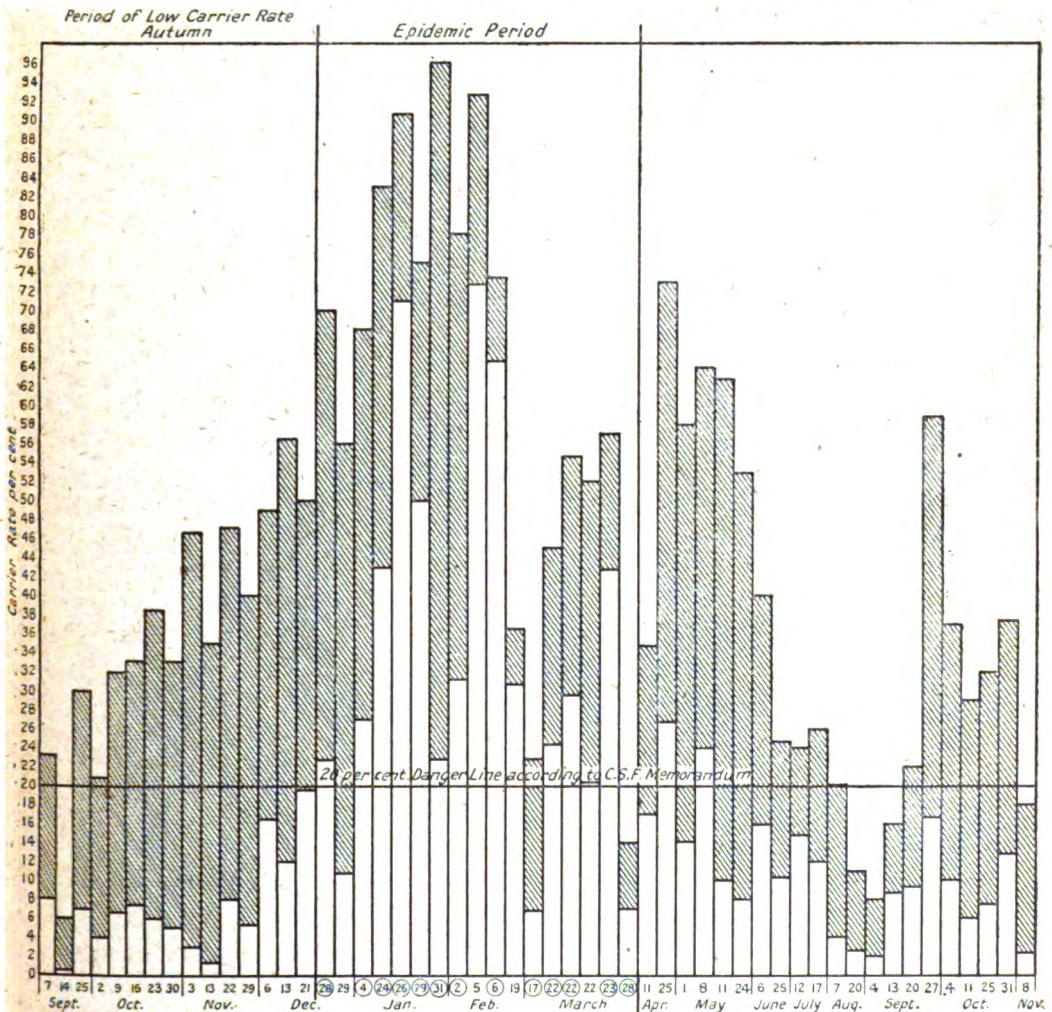
CHART B.
CEREBROSPINAL FEVER, "X" DEPOT.

1917 EPIDEMIC.

Relative percentages of:—

- (1) Carriers of Gram-negative cocci morphologically indistinguishable from meningococci, but not qualifying serologically as such—shaded columns.
- (2) Carriers of meningococci serologically proved—plain columns.

Showing the greatly increased proportion of the latter during the epidemic period.



Ringed dates = contacts of cases thus, Jan. ④
Plain dates = sample swabbings.

32 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

Carrier rates per cent of :—

- (1) All organisms morphologically resembling the meningococcus.
- (2) True meningococci, i.e., those which agglutinate with one of the four standard types.
- (3) Inagglutinables with standard sera.

Date of swabbing				I Contacts (usually 30) or Non- contacts, usually 100-120 men	Percentage of carriers of all organisms resembling meningococci	II Real carrier rate : percentage carrying agglutinable meningococci	III Percentage carrying non-agglutinable cocci
Sept.	7	..	..	Non-contacts ..	23·5	8	15·5
"	14	..	..	" ..	6	0·75	5·25
"	25	..	..	" ..	30	7	23
Oct.	2	..	..	" ..	21·5	4	17·5
"	9	..	..	" ..	32	6·5	25·5
"	16	..	..	" ..	33	7·5	25·5
"	23	..	..	" ..	38·5	6	32·5
"	30	..	..	" ..	33	5	28
Nov.	5	..	..	" ..	46·5	3·25	43·25
"	13	..	..	" ..	35	1·75	33·25
"	22	..	..	" ..	47	8	39
"	29	..	..	" ..	40	5	35
Dec.	6	..	..	" ..	49	16·75	32·25
"	13	..	..	" ..	56·5	12	43·5
"	21	..	..	" ..	48	19·25	28·75
"	29	..	..	" ..	56	11	45
<i>Epidemic Period begins here.</i>							
Dec.	29	..	..	Contacts ..	70	23	47
Jan.	4	..	..	" ..	68	27	41
"	24	..	..	" ..	93·5	43	40·5
"	26	..	..	" ..	90·5	71	19·5
"	29	..	..	" ..	75	50	25
"	31	..	..	" ..	96	23	73
Feb.	2	..	..	" ..	78	31·25	46·75
"	6	..	..	" ..	73	65	8
"	5	..	..	Non-contacts ..	92·5	72·5	20
"	19	..	..	" ..	36·5	30·75	5·25
March	17	..	..	Contacts ..	23	7·75	15·25
"	22	..	..	" ..	45	24	21
"	22	..	..	" ..	54·5	29·5	25
"	23	..	..	" ..	57	42·75	14·25
"	22	..	..	Non-contacts ..	52	20	32
"	28	..	..	Contacts ..	14	7	7
<i>Epidemic Period ends.</i>							
April	11	..	..	Non-contacts ..	35	17	18
"	25	..	..	" ..	72·5	27	45·5
May	1	..	..	" ..	58	14	44
"	8	..	..	" ..	64	24	40
"	11	..	..	" ..	63·5	10	53·5
"	24	..	..	" ..	53	8	45
une	6	..	..	" ..	40	16	24
"	25	..	..	" ..	25	10	15

VII.—AFTERMATH OF THE EPIDEMIC.

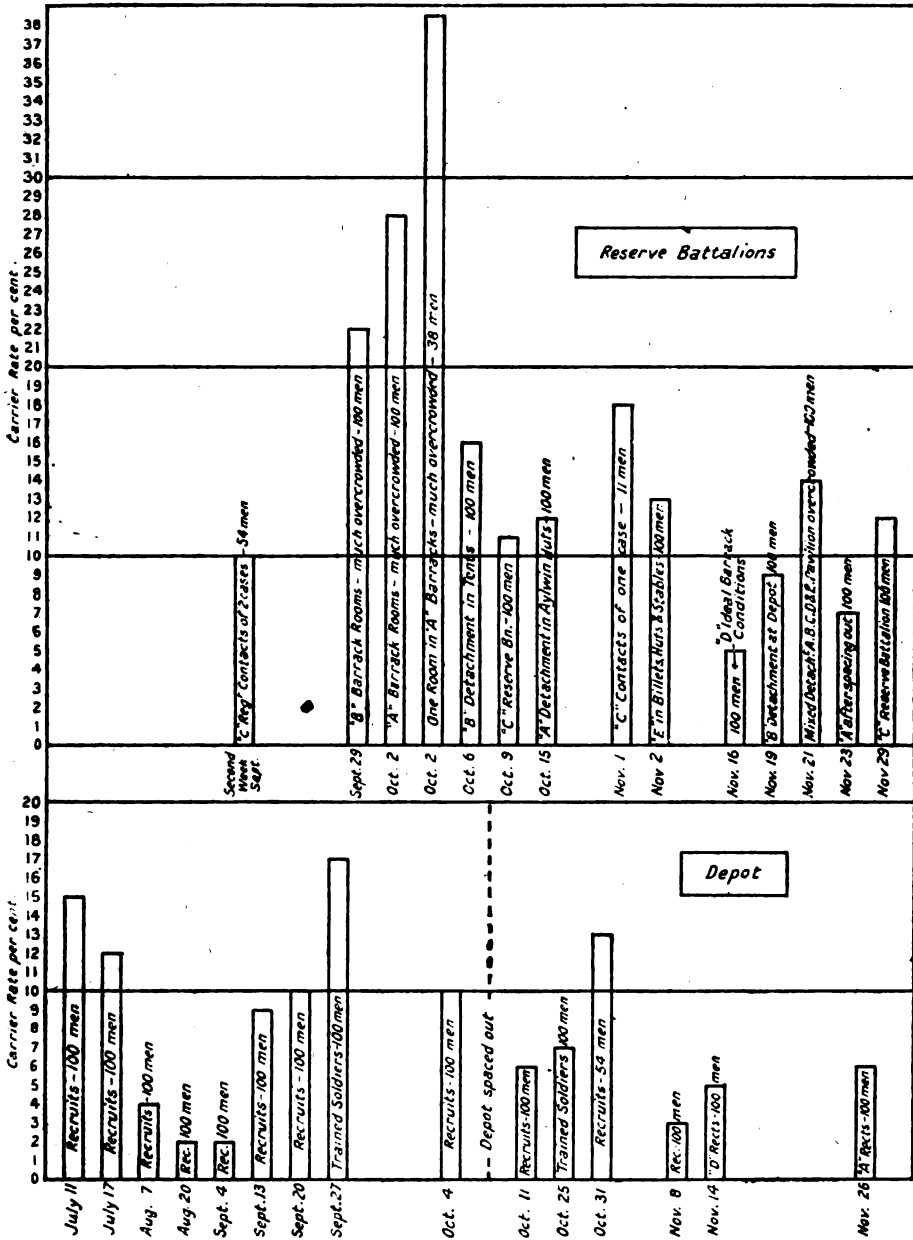
The carrier-rate of the depot remained high up to August, when it dropped suddenly and reached the nadir of two per cent, which may be regarded as the irreducible minimum.

In mid-July it had reached fifteen per cent, and large drafts being sent to the various Reserve battalions, some to barracks which were in a very crowded condition, a rather alarming series of events occurred.

CHART C.

AFTERMATH OF THE EPIDEMIC.

Showing high carrier rates in the Reserve Battalions fed by "X" depot. Autumn, 1917. With concurrent carrier rates at the depot (only carriers of serologically proved meningococci included).



34 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

At the barracks of "C" Regiment (which, it will be remembered, had been characterized by a somewhat low carrier-rate and its correct proportion of cases (4) to its strength at the depot) a sub-epidemic of three cases with two deaths occurred in September.

All three cases were in the same block of the barracks, an old building of bad design and with bad ventilation. All the patients had come within a few weeks from the depot at "X." All suffered from the invasion of Type II meningococcus. The contacts and a large sample of 100 men alike showed a carrier-rate of eleven per cent.

After these cases, samples were taken of the Reserve battalions of "A" and "B" regiments, whose barracks were 22 miles apart. In both there was considerable overcrowding. The barrack-room sample of "A" showed the alarming figure, especially for early October, of twenty-eight per cent, one large room reaching the appalling rate (for the season) of 38.75 per cent. "B" showed the high figure for barrack-rooms of twenty-two per cent (September 29), and of sixteen per cent for men under canvas (October 6). On each occasion, 100 men were sampled.

The Reserve battalion of "D" under ideal barrack-room conditions (November 16) gave a carrier-rate of five per cent, and the Reserve battalion of "E" under only fair conditions, somewhat crowded in a mixture of billets, huts and stables, had thirteen per cent.

How closely the meningococcus carrier-rate is correlated to overcrowding is shown not only by Chart A for the depot (black line), but by the experience with these reserve battalions.

"A" having had to furnish large drafts is now comparatively well accommodated and is almost down to peace strength accommodation (sixty feet floor space per man). Beds have been spaced out and the carrier-rate on November 23 was just a quarter (seven per cent) of what it was on October 2, whilst the large room that had had the thirty-eight per cent carrier-rate, when badly crowded, has now but 4.5 per cent.

Fortunately, no further cases of the disease have occurred attributable to the depot epidemic as yet.

These high carrier-rates have been largely due to an autumnal renaissance of Type I, a phenomenon seen on a smaller scale last year. The three cases, however, were all due to Type II.

VIII.—SUMMARY.

(1) There were nineteen cases and eight deaths at the depot during the epidemic. One doubtful case during this period recovered, and a sporadic case in June due to Type I also recovered; these are not included in the above, nor is one man who went on leave to Blackpool and developed the disease (Type II) on arrival.

(2) So far the Reserve battalions have had three cases only, with two deaths, although a high carrier-rate wave has been detected in two.

(3) All the cases (except the June case) at the depot occurred during exceptionally cold weather. In the chart the cases appear to lie in the

trough of a great depression of the curve of mean weekly temperature (dotted line). They also follow immediately upon exceptional overcrowding (black line).

(4) There was a well-marked premonitory rise in the carrier-rate in December, 1916, before the first case occurred, and an enormous rise before the epidemic was really established. The carrier-rate, which was 19.25 per cent on December 23, reached what is usually considered the danger point of twenty per cent (see War Office Memorandum on Cerebrospinal Fever, p. 2), just six days before the first case occurred. It would appear that *estimations of the carrier-rate by means of large sample swabbings afford a reliable warning of the imminence or danger of an epidemic.*

(5) The cases in the epidemic were nearly all due to the meningococcus of Type II, the organism present in the outbreak of 1916. The rise in the carrier-rate was also chiefly due to the increase of carriers of this type. Freshly joined recruits showed few carriers at all, and very few Type II carriers, when swabbed before having slept in the barracks.

(6) During the epidemic, the carrier-rate among non-contacts was substantially the same as amongst the actual contacts of cases, being thirty-four per cent average for the period in each case.

(7) The proportion of agglutinable strains to inagglutinable strains of organisms morphologically indistinguishable from the meningococcus increased very markedly during the epidemic period.

(8) The treatment of the whole population by the steam zinc sulphate solution spray (which was carried out daily for two seven-day periods with an interval of a fortnight) was followed by a satisfactory drop in the carrier rate, and by a temporary cessation of cases on each occasion.

(9) Sixty per cent of the actual patients suffering from the disease were in their first month of service. Forty per cent of the patients had either been inoculated or vaccinated within seven days of onset (three on the same day); sixty-five per cent within a fortnight.

(10) Previous and concurrent epidemics of German measles, influenza and bronchitis had helped (by causing coughing and sneezing, and by lowering vitality) to produce the great rise in the carrier-rate, which culminated in the case epidemic.

IX.—PROPHYLAXIS FOR 1918.

The carrier-rate in August dropped to two per cent. This was evidently the acceptable time to try to prevent by early measures a return, for the fourth time, of the disease in the coming winter. Accordingly, following the lessons, bacteriological and otherwise, of the 1917 epidemic, a scheme was produced by the kind help and co-operation of the Commandant of the depot, and of the Senior Medical Officer. It received the permission and the backing of the authorities, particularly the very kind and prompt help of the D.D.M.S. and the S.S.O. of the district, after it had been submitted to the valuable advice and criticism of Lieutenant-Colonel Gordon of the Central C.S.F. Laboratory. It has been carried out in excellent

36 *The Cerebrospinal Fever Epidemic of 1917 at "X" Depot*

time and awaits, with some trepidation on the part of the officers concerned, it must be confessed, the verdict of the coming winter.

The chief prophylactic measures are :—

(1) Spacing out of beds to a minimum interval between beds of $2\frac{1}{2}$ feet. To do this means a reduction of 1,266 beds under mobilization standard. The depot being much less full than last year, the extra accommodation was obtainable, the chief difficulty being that extra huts occupied meant extra fuel, and fuel is issued on a scale of men and not of huts occupied. This difficulty, however, was soon overcome by the recommendation of the D.D.M.S. and no hut has now more than twenty-four beds as compared with thirty-two last year. The difference in the general amenities of life is very striking, and the comfort and appearance of the huts is much increased, apart from the diminished risk of the spread of any catarrhal diseases. No barrack-room has now more than twenty-six beds in it.

(2) Special ventilation is being arranged, four windows in each hut are being fixed open (15°) with hopper sides, and with a prolongation of the outside weather-boarding to give an upward direction to the air and to prevent driving rain and snow. Four windows are also being fixed slightly open in each barrack-room.

(3) During the danger months, December to March, anti-typhoid inoculation is to be done in the second month with fourteen days between doses; vaccination is done in the first month, great care being taken, as was done previously, during the period of vaccinia malaise.

(4) A hut has been adapted, as a special spray chamber with an external boiler and twenty Hine's jets, under the direction and supervision of Major Hine. This is capable of spraying 120 men simultaneously and can be filled with spray vapour in two minutes. The atmosphere is not vitiated by the fumes of the burning spirit as with the Levick spray; it remains quite cool and pleasant. It is proposed to spray each of the five regiments in rotation every day for six days once a month, if any rise takes place in the carrier-rate sufficient to appear a warning. It is also proposed to spray all recruits on entry for their first six days, and, if the carrier-rate of the depot be higher than that of the Reserve battalion (at present it is lower), to spray all drafts leaving the depot.

(5) The medical inspection premises are to be enlarged. Every recruit has to go to these at least four times for examination, vaccination and two inoculations. During the last epidemic, the premises, being most inadequate, were always very crowded, and probably a fruitful source of infection. Practically all the nurses and orderlies working in them became temporary carriers during the epidemic.

(6) A large sample swabbing (100 men) is taken weekly and affords a guide to the current carrier-rate.

In conclusion, acknowledgment must be made of the invaluable help of Serjeant Barrett, Corporal Piejus and Private Dimond, of the Royal Army Medical Corps. Without it, the many thousand examinations, which form the basis of the paper, would have been well-nigh impossible.

THE MUSINGS OF AN IDLE MAN.

By COLONEL R. H. FIRTH, C.B.

I.

AT mess, a few evenings ago, the conversation turned on the relative value of the sciences and the humanities as educational methods. As a man who has trifled with both, the temptation was irresistible to say a good deal. I do not propose to cover the ground over which our arguments wandered, but rather to jot down certain reflections on the broad question as they occurred to me the following day while lazing in a field. Clearly, both the scientific and the human method are approaches to a common end, which is the improvement of the world. The characteristic of the scientific method is that it makes its god in its own image, has a point of view of its own and maintains it dogmatically; it treats men objectively and is concerned with our actions on them while ignoring the effect of their actions on us. Suppose we take the case or question of duty; by the scientific method this means our duty to others and, having discovered what our duty is, it allows the others no right of appeal. On the other hand, the human method takes the point of view of the people whose interests are under discussion and, in the case of duty, recognizes that I am myself and that you are yourself and does not admit that any others exist. Obviously, as methods, the scientific and the human are opposed, but they have the same object and each is necessary to the other.

The current phrase "the greatest good for the greatest number" reveals aptly the scientific mind, as it thinks of men as units. Humanism or the humanities can make nothing of that formula, because it cannot regard man as a unit to be totalled, subtracted, multiplied or divided, but rather as a queer being of whom you can never predicate his next action. The eccentricity of man, science reduces to an average, whereas to humanism the average is eccentric. One can almost say that science issues commands while humanism issues entreaties. The difference between the two is that between the man who begins by giving you a penny and the man who begins by asking if you would like a penny. Both aim at doing you good and both desire your co-operation; but the scientific defines the form any co-operation must take, while the human leaves you free to choose the form for yourself. Similarly, in matters of self-defence the scientific method allows us the right of self-defence only against those who would do us harm. The human method allows, in addition, the right of self-defence against those who want to do us good. The first is the more logical and consistent, the second the more generous. From this it follows that the humanities never press a reform upon men without first consulting them as to whether they want the particular reform. Science concedes the same point but discounts it by insisting that people do not know what they want and consequently claims the right to inform them.

If one is correct in these views, it is obvious that the world would be in a bad way if either science or the humanities were left in exclusive possession of the field. In the one event there would be intolerable tyranny, and in the other intolerable confusion. We should gain nothing by the final overthrow of either school; on the contrary, our best interests are secured by both methods continuing to gain in strength and determination. Very much as the best football is seen when the two opposing teams are evenly matched, so in philosophy the clearest light is that which arises from the keenest opposition. The conclusion, therefore, is that if science injures humanism it weakens its own inspiration, and the humanism which injures science destroys its own tools. This brings us back to the fundamental axiom, that the value of everything in life depends on a certain admixture with its opposite. So we need not be surprised if the ultimate relation of science and the humanities is that of hating and loving each other at the same time.

As regards the main theme which started these reflections, it is of the utmost importance that our higher education should not become materialistic through too narrow a regard for practical efficiency. As the mother of all technical knowledge, science is essential to our industrial prosperity and national safety, but its limitations are so defined that it is impossible to accept it as a complete scheme of education because education is and must be nothing less than a preparation for the whole of life. It should introduce the future citizens of the community not merely to the physical structure of the world in which they live but also to the deeper interests and problems of politics, thought and human life. It must acquaint them with the capacities and ideals of mankind, as expressed in literature and art, with its ambitions and achievements as recorded in history, and with the nature and laws of the world as interpreted by science, philosophy and religion. As a means to this end, the limitations of science divorced from the humanities are definite. If we neglect science, we get but an imperfect knowledge of the world around us; but if we ignore or subordinate the other elements of knowledge, as opened by the humanities, we cut ourselves off from aspects of life of even greater importance. Our aim should be a training which gives width of view and flexibility of intellect. Science itself, industry and commerce will be most successfully pursued by men whose education has stimulated their imagination and widened their sympathies. In this education, the study of the literature of Greece and Rome must have a large part, because our whole civilization is rooted in the history and mode of thought of those lands and peoples. We do not need either science or the humanities to be rampant to the exclusion of the other, but we need both working in all the branches of our education so that it may develop human faculty and the power of thinking clearly to the highest possible degree. In this sense, one conceives no direct hostility between science and the humanities, neither hating the other as a rival, but rather loving one another as rivals for knowledge and progress. May it be so.

II.

At parade service, the other day, our padre gave us a homily on avoiding worldliness. He spoke of it from the religious point of view, therefore I do not propose here to criticize his arguments or teaching, but rather to set down some thoughts which his allusions to worldliness suggested. From the lay point of view, worldliness means a knowledge of the world and is no class vice. As a matter of fact, it is not a vice but merely the misuse of a gift which is to a great extent intuitive. Most of us wish to have a knowledge of the world, and some wish it so keenly that they think they have attained it. We men admire it in each other, but few of us entirely like it in our women. The worldly-wise woman has a sense of superiority and she is apt to make it felt. She goes armed, and has seldom that hesitation to inflict pain which characterizes adorable women. In spite of that we forgive her much because she bores no one. This suggests the doubt whether worldliness is to be found in the very highest characters. Certainly not in those whom we call very lovable people, because these latter usually have a simplicity or innocence all their own which verges on the maladroit, and which is a characteristic men of the world conspicuously lack. All the same, it is the simple lovable people who are the salt of the earth, as they believe in the world, not having been born to know it.

What the French call *savoir faire* comes quite naturally to some boys and girls, but on the whole one is inclined to think that a fairly hard life is more likely to make a man worldly-wise than an easy one. Suffering sharpens wits in all directions, and worldliness in its most crude form is more common where the struggle to live begins early and is continuous. Talk to the woman of the slums and she will tell you that she "knows her company," which is but the shrewd cynic saying that she sees through it, has no illusions, and tastes its bitterness. In its finer sense, worldliness is found in the better classes and there to know the world is to like the world, perhaps not untinged with a contempt for it and a desire to worry it. This reminds me of a true but curious fact that two worldly-wise people seldom mate together. If they did, enthusiasm in the children could hardly exist. This may be the clue to the answer to the question, Why do so many able men marry fools? It is because they have too much ideality and seek an object for worship, and the few women who deserve worship are those who have not too much of that worldly common sense and social presence of mind which distinguish a woman of the world. Of course, it may be said that fools have not those attributes either, but saints and fools are easily confused when they are young and pretty. The most objectionable feature in worldly wisdom is the sense of self-satisfaction which it engenders. This is confirmed by the circumstance that those who bring about improvements in the world are not those who have the greatest knowledge of the world. If we recall the truly great men, it is hard to say of any one of them that he was a complete man of the world.

The conclusion forces itself that men and women with a knowledge of the world are so interested in the drama of life that they care for nothing outside it. The only compensation lies in the thought, perhaps it is as well that in this transitory life there are some people who do succeed in making themselves thoroughly at home.

III.

The big part which the Dardanelles and its adjacent coast have played in our recent history tempted me to look up our old friend Homer, and so wile away some odd hours. I remember well, as a boy, regarding Homer's stories as a myth invented solely to worry the youth of later generations. Homer himself may be a myth, but his Troy certainly is not, for we know that the Mycenæan walls have been uncovered and explored at Hissarlik. It is difficult to suppress the wish to go and see the place, for one can no longer disbelieve in it than, in spite of the Minotaur, one can disbelieve in the Cretan labyrinth. The theory of the schools was, that the Homeric story was but a transplantation of legends and that the Trojan war was but a reflex of some war fought elsewhere and, in much the same way, regarded Achilles and Agamemnon as humanized gods passed down from pre-Hellenic times. One reads the story again in riper years and, as one thinks it over, we see Troy not only a fortress whose lord could levy toll on merchants from the south wishing to tranship their goods across the isthmus to the sea of Marmora, but we see Troy as a sentinel commanding the passage through the Dardanelles, the command of which passage was as important three thousand years ago as now. Old Greece needed corn and had to import it from the Euxine cornfields, and though old Thucydides hints that the whole story of the Trojan war "incredibly prevailed towards the fabulous," we feel, in the light of our own efforts to force the passage, that then as now a war did rage over the bone of contention and, moreover, a war characterized by equally noble and almost fabulous deeds.

History and Homer are clearly the same terms, though perhaps not untinged with the twining of fable about truth. Homer's Greece is very real and as interesting, if not more so, as the Greece of Constantine and Venezelos. Of course, there are many gaps we would like to see filled. We long to know the truth about the old Pelasgian inhabitants of that country, and of the Minoan civilization down to 1500 B.C., and how, a hundred years later, the Achaian warriors came from the north, conquering and building castles much as the Normans did in our own land some twenty-five centuries later. Oddly enough, I have recently re-read "Ivanhoe," and every Norman baron of that romance has his Homeric prototype, for Norman and Achaian are as twin brothers. Homer's warriors go forth to battle clad in mail, all disdainful of the common varlets, whom they slaughter like sheep, but ever ready for a combat with

a worthy foeman. Good eaters and drinkers are they all, lovers of the "larger mixing bowl" and the "lengthy chine," γῶτον διηνεκες; while, when the feast is over, they listen to the minstrel as he sings of love and devilry, κλέα ἀνδρῶν ἡρώων. One imagines them all as hard men with few scruples, often wily like Odysseus and yet not more reverent of Zeus than Bois de Guilbert was of the Mass, but with just as keen an eye for fair women; men who would not give up a Briseis or a Helen, or starve when there was anything to be stolen; all the same, real men who loved life, lived to the full, and whose souls passed indignantly into Hades. It is a fine picture, for over them all ruled Agamemnon, perhaps no greater warrior than some of our Norman kings were, but, carrying the royal sceptre that Hephæstus wrought, he gave them that unity which makes for strength. Some of the old Greek barons were hard at times to keep in hand, and we conceive Achilles as troublesome as Hotspur, but in the end obeying. Though Agamemnon may not be an ideal personage, yet he is the central figure of the "Iliad," just as his palace fortress of Mycenæ was the very centre of Greece. All roads led to Mycenæ in those days, much as they lead now to Constantinople, and so we picture its occupant, close under the spider mountain, Ἀραχνᾶιον ὄρος, waiting to pounce upon any intruder. More than that, one recalls how the small city communities of old Greece created the intellectual life of Europe. In their literature we find models of thought and expression, and meet the subtle and powerful personalities who originated for the Western world all forms of poetry, history and philosophy, and even science itself, no less than the ideal of freedom and the conception of a self-governing democracy. For those ideals, our many dead rest on the arid slopes of Gallipoli and almost within sight of where Troy stood. It is all an old theme, but yet a fascinating theme in a time like the present when the Trojan war appears dwarfed as but a border foray. To write all this may savour little of medicine or of war, still it is a passing pleasure to break away and be able to forget both.

IV.

While I do not admit to being a persistent fault-finder, still I do plead guilty to a certain pleasure in noting faults, or what I think are faults, in others. It is a harmless vagary, but it affords me some amusement and helps to fill up time. If we look around us and contemplate our friends and acquaintances, it is astonishing to find how much a man's agreeableness depends upon his faults, and like his coat those faults may sit ill or well upon him. Thus, the same faults do not become rich and poor, or old and young, and many faults which mar a man would alienate a woman from us. We forgive boasting or excessive pride in some belonging to a poor man, but let a rich man boast and we at once are repelled. On the other hand, Dives may be a little inquisitive or interfering without incurring social ostracism, but Lazarus must be content to be reserved and retiring.

In the one case, the tendency to be officious is charitably supposed to spring from benevolence; in the other, a reserve is held to be becoming which in one more opulent would pass for pride. So again, we can forgive much to young people if only they are young enough, but even so there remain a few faults which suit the old only. A young man should never be sententious or pose as an intellectual, whereas an old man may be something of a prig and yet remain an agreeable friend. Conversely, contentiousness is as forgivable in a youth as it is detestable in an old man. The same can be said of philandering, which ever makes an old man appear as a fool, no matter how harmlessly he philanders; but in youth the prosecution of light-hearted love is no offence. A sharp tongue, with some hot temper, does not make us love pretty Kate the less, though the slightest suspicion of shrewishness in her mother suggests the giving of a wide berth to that lady.

A neat point occurs; it is this: Can a man alter his faults to suit the circumstances? I think so. I know two men, both of whom are arrant snobs. The predilection for the company of his social superiors suits one because his good manners and fine temper smooth his relations with all and sundry, making him no unpleasant companion. The other carries the garb of the courtier badly, and we detest him for a bumptious toady. It is difficult to explain the reasons for the difference, but a possible explanation is that the one knows his weakness and cultivates the corrective of all-round geniality; the other has never troubled to find out his defect or to take the hint of its existence from others. In the one case, the fault verges on the becoming, in the other it is repellent. The truth is we all have our faults and virtues, but some carry them better than others, or it may be that we do not go to the right spiritual tailor to have them properly fitted on.

V.

A man dropped in to lunch the other day, who was of a prepossessing appearance, had good manners, but particularly remarkable for a large forehead and brilliancy of his conversation. After he had gone away, some one remarked, "That was a brainy fellow." I demurred to the fitness of the comment and suggested that he would be described better as an intelligent fellow. The incident, trifling in itself, suggested later on a line of thought which may be worth following. The question is, Is to be brainy and to be intelligent the same thing? The answer would seem to be, no; because a man may possess a large and well-developed brain and yet be a great fool. Then what is a great fool? Obviously, he who possesses but mismanages a large and well-developed brain. The essence of the problem lies in the recognition that the possession of brains is one thing, their management is another. The only fallacy about this statement is that there may be a form of brain development which carries a guarantee for its right management. As it is some years since I read anatomy and

physiology, I leave the proof of the fallacy to those who are better and more recently informed than myself.

Few will deny that of all the assets given to the use of man the brain is the most difficult to manage properly, and the range of its possible mismanagement is as wide as the penalties for that mismanagement are great. Of course, some may say the brain is self-managing, and the most highly developed brain the best managed. If so, what right has any one brain to interfere with any other in the management of its own affairs? And any reader objecting to my views is clearly interfering with my brain; moreover, he will not improve the situation by alleging that his is a bigger and a better managed brain than mine. No, the conclusion is obvious that high foreheads and big heads are no guarantee of wisdom, and the highly developed brain is as much the property of the rogue as of the philosopher. Further, if the progress of mankind be synonymous with the development of the human brain, then the final stage of progress may be the appearance of a race of ingenious rogues and fools. It appears then, we must fall back on something else which we may call intelligence.

But, what is intelligence? Frankly, I do not know, but I have no doubt as to its value. If I have a doubt, that doubt reposes on intelligence, appeals to intelligence and requires intelligence for its expression. The alternative would be that the doubt is meaningless. Without intelligence we could not know what was love, faith, instinct, intuition, or will, and many other things. Without intelligence, a man might think he was living by faith and yet be living by prejudice, or he would mistake bad reasoning for intuition. The more we think about it and use our intelligence, the greater is the tangle and the more we realize that no man requires so much or more intelligence as the man who turns his back on intelligence and decides to live by something else. It is useless to suggest that conscience will take its place, because it requires intelligence to know what conscience is and what it is not. Whichever way we look and however much we may argue, the fact presents itself that we are begging the question as to what is intelligence. Therefore because I cannot define intelligence it does not lessen the justness of my definition of our visitor, that he was an intelligent fellow rather than a brainy man. We have to be content with recognizing intelligence by its fruits, leaving it open to argument as to what are and what are not its fruits. The conclusion may not satisfy everyone, but it will produce less disagreement than any other, and at that it is wiser to leave it.

VI.

In the mess in which I live we have a man who is a bit of a character. He has had a varied career, from stowaway on a tramp steamer, through mining in Alaska and lumber rolling in Canada, to his present position as a captain in the new Army. Needless to say, he is full of interesting information, but his chief charm lies in his simple directness and independence,

for he has his own ideas with no scruples in declaring them, and a definite indifference to criticism. In contrast to him is another man who, though extremely well informed and experienced, is so sensitive and shy that it is only by constant association that his messmates realize his sterling worth or the value and range of his opinions. Like the other man, he is indifferent to criticism and yet sensitive to it.

I have often contemplated these two men, for they seem, in a way, to represent the main groups into which one's acquaintances fall. That is, there are those who resent criticism and those who do not; those who are preoccupied for the safety of their reputations and those who never give them a thought. A man indifferent to criticism is often called a strong man; he has, doubtless, some great qualities, but he is not without serious defects. Strong men are not always just men, as I know only too well from official experiences. And the man who does not mind injustice will often do injustice; moreover, in this respect, the so-called strong men get far more credit than they deserve, because prejudice is a common corollary of strength. The man who is above resenting what is said of him is above revenging himself; though he will not take offence, he frequently takes the offensive, and that unjustly. Equally, the sensitive or shy man has some weakness in his character, but he may have powers which the man made of sterner stuff is without. A man sensitive to criticism is sure to study his critics; he can accept suggestion and appropriate the moral and mental inspirations of other men, which means that he has more power of development than stiffer natures possess. Moreover, he is a better representative of others than a more naturally independent person can be, and this, combined with a stronger feeling for justice, marks him out as fitted to be a leader.

If we analyse the curious form of mental independence against which criticism is powerless, we find that it may be the result of more than one cause. In some men it is an innate quality, and in them arises either from sheer egotism or from sheer goodness. By this latter term is meant the quality which enables a man to hold himself answerable to no tribunal but the highest, and we can label that tribunal as being either God or conscience. Whether egotism is a vice is open to argument, for it depends on the ego. It is one of those qualities with which some people are born, and which they never shed. Though the egotist is more or less wrapped up in himself, it seems a mistake to label him dogmatically as either selfish or unlovable; if the ego be good, an egotist can be a saint just as, if the converse exists, he becomes a sinner. Egotism ever makes a person a definite character, and his characteristics can be as often good as bad. Apart from these causes, there is a type of independence which is not genetic. It is represented by people who are quite indifferent to what friends or foes say of them, because custom has made them content to be misunderstood. Most of us have met with instances of the kind, and not infrequently it is traceable to an upbringing in which, from infancy, the individual has been

trained not to expect sympathy. The result is, he has learned to live alone, and does not think that any man's goodness or badness, ability or stupidity, has reference to his own particular ideas. Complete reserve of this kind is rare, but it exists.

In contrast to these people are those who take so much pleasure in notice that even blame is agreeable. We meet with this keen desire to be in the limelight often in children and, as an undignified trait, is best dismissed as a puerility. Then there are a few men and women who do demand sympathy, and wish to make a favourable impression on a few, and yet are sufficiently exclusive to be indifferent to public criticism. These people are met in all grades of society, and their peculiarity is that only a small circle of acquaintances are real to them, and to whose criticism they are sensitive; to them the rest of the world is an illusion or artificiality. These peculiar people belong generally to special cults and coteries. Their view of life simply proves them to be ill-endowed with imagination and, perhaps, after all, it is want of imagination which accounts for my two messmates being, each in his own way, so indifferent to criticism.

VII.

It will be conceded that in attempting to trace the incidence of the infectious diseases, such as enterica, measles, diphtheria, small-pox, and scarlet fever, it is a case of *cherchez l'homme*, and that it is the human rather than the dead structural elements of our surroundings to which we must look for any persistence of infection or infectivity. For enunciating the opinion that the disinfection of rooms, billets, and houses, after these diseases, was unscientific, illogical, wasteful of public money, and suggestive of charlatanry, I was twitted recently as being unorthodox. Assuming that to be orthodox means to think what is right, then to be unorthodox means that I think what is wrong. I do not propose to discuss whether my views on the subject of disinfection are right or wrong, as that is a matter which can be best left to doctors; but I do propose to put down some ideas which are suggested by the quality of being either orthodox or unorthodox.

In the present day the application of the term orthodox has acquired something of a contemptuous sense. Thus, to say that an opinion is orthodox is tantamount to saying that it may be, and probably is, right, but it does not deserve to be. It is difficult to explain why this should be, but may it not be that some of us feel an impatience not really for the opinion held, but for the manner in which it is held? This means that the personal factor of the sayer tinges what is said. Truth in the abstract is simply truth, but directly men explain it or act on it, they seem to colour it with their own peculiarities. Of course this does not apply to scientific truths. These differ from any other kind of truth, because they only hold their place as truths owing to their being continually confirmed by experience. The confirmation by experience of many scientific truths is limited to the few

who have sufficient scientific knowledge to experience them. For the mass of people there is neither the knowledge nor experience, therefore they accept the opinion of those few, trusting them to believe nothing that is contrary to their experience. Indeed, it is a point of honour with the scientific conscience to believe nothing that is contrary to experience. Other truths, or what we may call moral truths, are concerned with facts which are within the experience of most people. It is true that some have to be acted upon without previous testing by experience, and we have to accept them because they are accepted generally. In doing this, there is the fallacy or danger that we may be acting not upon our own convictions but upon the convictions of others. Those convictions may be perfectly right, but if they are not our own, we cannot commend them to others, and the man that utters opinions without personal conviction expresses a mere platitude, and arouses that prejudice against truth which finds expression in the contemptuous use of the word orthodox.

If the foregoing train of thought is sound, it follows that to be unorthodox may be a creditable attitude. Unorthodoxy involves the taking of an independent line and it means that the man who elects to be unorthodox has, or should have, the merit of believing what he says and does. He expresses no platitude and may be an evangelist, though often, like another prophet, he may be crying in the wilderness. But there is ever the danger that unorthodoxy may get out of hand, leading to the airing of cranky ideas due to a loss of proper perspective. We need to distinguish between the unorthodoxy in small things and the unorthodoxy in matters of greater importance. The lesser unorthodoxy is often only a sacrifice of small to great things, and some may take pleasure in it as a protest against the sacrifice of great things to small. Thus, among the well-to-do, it is more unorthodox to be dirty than to be ungodly. Similarly, among the poor, it is less unorthodox to have an untidy house than to imitate the domestic order of the rich. If a man likes untidiness and disorder for their own sakes, then his unorthodoxy has begun to pervert his judgment, and he becomes himself a proof of the value of the lesser orthodoxy which he despises. So, a godly man who rolls deliberately in the mud to show his contempt of cleanliness proves thereby the value of cleanliness to both body and mind. Cleanliness and order in themselves are good things, and they are only objectionable when better things are sacrificed to them. Provided, therefore, we do not allow our unorthodoxy to go so far as to affirm that good things are bad, because they happen to inconvenience us, no harm results. The fact is, we cannot pick and choose among those things which the common consent of mankind has decided to be virtues or vices. If we do, we deny the whole moral sense and decry our own powers of judgment. Further, if we deny the justice of the emotions, or the rightness of a virtue, or a vice at any one point, we must deny it at all. But no one has ever succeeded in doing that, consequently unorthodoxy, whether of individuals or societies,

is always open to the criticism of being inconsistent. Therein lies the gist of the whole case ; unorthodoxy is only discreditable when it is based on wrong premisses and so warps our judgment as to lead to illogical, unscientific and immoral actions. The allegation of my own unorthodoxy, therefore, remains to be proved, and the proof turns on whether the initial premiss on which it is based be devoid of scientific truth.

VIII.

A curious feature of this War is the number of young men who are holding comparatively high staff and administrative appointments. In my own service, I see the administrative charge of divisions in the hands of men some ten or twelve years below the age at which those positions were reached in normal times. It is the same with all other appointments, where it is rare to find a divisional commander over fifty, or a brigadier over forty-five. The converse prevails also to some extent, for the War has brought back to duty many men who had long since hoped to have shaken the dust of soldiering off their boots for good. But these men are mostly holding easy jobs.

As one looks around and ponders, one realizes how much the whole business of war has divided old men and young. The picture has its bright lights and also its shadows ; these contrasts become all the more apparent in the amenities and familiarities of daily life in mess, where the greater number are young or relatively young men. Listening to their confident and cheery talk and also to their frequent iconoclastic generalizations, one realizes that there is a barrier between the old and young. It is difficult to avoid being critical, and one has to admit that youth is a fault which, though it is sure to mend, age does not always find it easy to forgive. Across the barrier, so hard to disguise, the generations discuss life. Old and young now put their shoulder to the wheel. Though a man be young and puts his shoulder to that wheel, you cannot put an old head on the shoulder ; the same is true, in an opposite sense, of the old. They still have faith in old specifics for the cure of the world. The young have made a fresh diagnosis. They flout experience, turn a deaf ear to precedent and prescribe a new remedy.

The situation is not without humour and pathos. The conclusion asserts itself that, only by an effort of mental detachment can those of an older generation bring themselves to understand that the rising generation is going to live its own life, that its life will differ in many respects from our life, that its heroes will not be our heroes, nor its ideals our ideals ; in a word, that the chicks of to-day are going to be the cockerels of to-morrow. Yet, in any true perspective of life, those coming on are probably just as worthy or just as unworthy of their places as the acknowledged actors of the past. The best parents are those who know when their children have become men and women, entitled to think and act for themselves, and that

friendly counsel and companionship must take the place of parental authority and tutelage. It seems a mere commonplace to say that we should judge each man of note on his merits, and not misjudge him because we have known him as a youngster and had not the wit to foresee that he was going to make his mark. Yet this is what many of us are constantly doing. We must give the young their due: we have had our day and doubtless enjoyed it. Anyhow, we must think we have. That is the true wisdom of advancing years, for undoubtedly half the art of life is the art of knowing when to abdicate.

IX.

When at home on recent leave, I filled up the dawdling hours of a wet afternoon by overhauling the contents of a long-forgotten box. What treasures I unearthed and what memories the sight of the old familiar objects raised! There were two old photograph albums and whole packets of loose photos, chiefly groups. This forgotten lumber seemed to speak, for it told only too eloquently the full story of my early happy and irresponsible days. As I sat there, gazing at those records of forgotten faces and discarded fashions, my heart was softened towards photography. The thought came, does there not lurk in some dark corner of every camera a good fairy who enchants every plate as it is exposed? True, from their very crudeness, many of the pictures were productive of a smile, but still an enchantment was there filling, after the lapse of years, each photograph with a curious grace. In spite of their coarseness and crudity of technique, one read into their unintelligent realism a virtue and a pathos such as is so often suggested by an old painting. When we look at an old picture or portrait it is hard not to think of him by whom it was painted, rather than of him who was portrayed. But, while the painter nearly always obtrudes himself on us in his work, few of us ever think about a photographer. Why? It is hard to say; possibly, because his work is done so quickly. And yet, that very rapidity of production makes every light picture which we call a photograph so real and, despite the conventionality and stiffness of the attitudes, so natural.

I picked up a particular group. How well I remember its being taken in the late 'seventies. It was in a college quad, and what a Babel of talk and laughter there had been, silenced only for a while as the artist said, "Now, gentlemen, just a moment," to burst forth again with double force when the camera had done its duty. There was I; even the suit I wore on the occasion came back to memory, and the ostentatious tie of which I then was so proud. Even the background had a sympathy all its own, for was it not the window of a certain room in which "old Shad" used to wax eloquent on the glories of the age of Pericles, or put our torpid brains through such mental gymnastics as explaining the subtle charms of anapæsts and iambics, or analysed for our benefit the wise sayings of Marcus Aurelius. What stories that window could tell. The long

procession of men who had gazed through its grimy panes. Men in whiskers and velveteens had given way gradually to men in morning coats and full trousers, and they again to those clean shaven and in dittoes or flannels. The very walls of the old familiar spot seemed to frown down in the picture on the kaleidoscopic pageant, the individuals composing which did and do not realize their transience.

Certainly not only this particular group, but all these old photographs were pregnant with an irony and a pathos. They were themselves as eloquent to me as the walls surrounding the places where they were taken. Then I scanned closely the faces and compared them with the nominal roll below. Some were easy to recall, others less so. Then came the thought, where are they now, these leaves which the unsparing wind of Time has scattered? Doubtless, in the "book of fate," the name, address, the past and future of every one of them are duly entered. Whether for good or ill, that book of reference is not available to us, and one has to make up for its absence by studying those old groups and guessing the character of every member from his lineaments, bearing, and what one remembers of him. As I looked through the collection and tried to reconstruct some of the life-histories of the members, I came across but one who achieved any great fame. In a particular group dated 1877, there he sat a solemn, heavy looking young man, a future Empire builder and name-giver to a province of twice the size of France. Except the well-marked nose, there is no feature to distinguish him from any around him. But I, who know now all that fate was holding for him, could not but linger at the sight of the face of him as I knew it in years gone by. I recalled how quickly the laurel branch grew for him, how it flourished only to be cut off, tragically and untimely, when most of its leaves were still green. There, in the half-light, I sat and wondered, was it better to be, as they who were there portrayed in that group with him probably still are, healthy, happy, sane, stupid and obscure, or have led, like that young satrap, a short meteoric life of triumph and some tragedy. Reverently, I packed the old collection of photos away and asked myself which of the two lots would one rather draw? Which was the better or the luckier? I did not know; and perhaps it is as well that I should not know.

X.

A few days ago, I found myself in an advanced dressing station just when a batch of wounded men were brought in from the regimental aid posts. Some were badly injured and, with critical interest, I watched the medical officers and orderlies deal with them. As I rode back to headquarters, my thoughts wandered back to what I had just left and the idea occurred how indifferent I and the others had been. They and I had taken in every detail of the suffering, had undoubtedly felt a sympathy, but, for all that, those things were not going to interfere with our appetite, our

sleep, or our enjoyment of the scheme of the universe. All this indifference was not the outcome of callousness, and yet it was an asset which I could not avoid placing on the credit side of the incident. In his endless fight with pain, the doctor cannot afford to go unarmed, therefore he induces by will-power an armour which we call indifference. Without that armour, the blows to which sympathy exposes all who tend the sick and wounded would soon lay them low. It is a pretty problem, and my ride home was taken up mainly with trying to analyse that psychological secret which is the calm that pervades the mind of every doctor and nurse in the face of physical suffering. True, my analysis was largely negative, still I was forced to the conclusion that the indifference was not an effort to avoid, or the result of an incapability of thinking, but rather an effort made by thinking to avoid pain.

Some may attempt to explain indifference as a mere product of familiarity with certain experiences; it is doubtful whether this is sufficient, because certain mystics live in a state of mind which is well described as indifference, and yet that indifference is originally no product of experience. Moreover, each one of us cultivates more or less an intellectual and emotional indifference as to certain subjects upon which we are reluctant to think. Take religion for instance; how many of us dare face the issues which such speculation raises? Many of us never enter that field of thought except in a drugged condition, and we seek indifference in conventional orthodoxy or conventional scepticism according to our environment, age and temperament. This and analogous cases are but examples of a genuine attempt to shirk all the pain and mental confusion which duty does not command us to endure. Then there is the indifference of the indulgent cynic which, sufficiently cultivated, makes him a man powerless to help or punish and equally incapable of sympathy or indignation. The typical exponents of indifference are the would-be stoics. In them pride forbids influence by grief or pain, whether their own or that of another. This class of person poses as having strength of mind and thinks by suppressing all manifestations of feeling to master all emotion. Another form of indifference is engendered by sheer experience. It is best seen in the victim of ill-luck or the man who, having lived on hope for years, at the last abandons it and acquires indifference by sheer will-power. The services are full of men of this kind. They see *Gazette* after *Gazette* appear, and their fellows either promoted over their heads or made recipients of honours, often both. Many succeed by an effort of concentration to raise themselves to a plane above such banalities, some fail and never acquire that indifference which spells peace. The truth is, we need to take trouble and disappointment simply; if we admit our misery, Nature will console us by the remedy of Time. True, it is a remedy in which but few find faith, but in a suitable dose it does heal most of those who are not too proud to give in.

REPORT UPON THE BACTERIOLOGICAL EXAMINATION OF ONE THOUSAND SOLDIERS CONVALESCENT FROM DISEASES OF THE DYSENTERY AND ENTERIC GROUPS.

BY CAPTAIN WILLIAM FLETCHER.

Royal Army Medical Corps.

From the Laboratory of the University War Hospital, Southampton.

(Continued from p. 693.)

Cultural Characteristics of the Strains of B. paratyphosus B isolated.—The cultural characteristics of all the strains isolated were those of classical *B. paratyphosus B*. They were all motile and none of them produced indol in peptone-water within a period of fourteen days.

The media employed were : (1) nutrient agar ; (2) peptone-water ; (3) gelatine ; (4) lactose ; (5) saccharose ; (6) glucose ; (7) maltose ; (8) dulcitate ; (9) mannite ; (10) dextrin ; (11) milk.

The cultures in peptone-water were examined for motility within twenty-four hours, and they were tested for the presence of indol, repeatedly, during a period of fourteen days, by the rosindol method.

The average amount of gas produced in glucose and in maltose was, approximately, 0·4 of the capacity of the Durham's tubes employed, and decreased to 0·3 by the end of fourteen days. In mannite a similar quantity of gas was produced, but it reached a maximum and stayed there without decreasing again. In dulcitate, about 0·7 of gas was formed which decreased to 0·5 by the end of a fortnight. Litmus-milk became acid on the second day and turned alkaline between the third and eleventh days (average 5·5 days). Dextrin became acid on the second day and formed a bubble of gas ; between the third and the seventh day (average 3·5 days) it became alkaline again and remained so.

In three cases (Nos. 159, 588, 36) more gas was formed from mannite than from glucose or maltose, and in five others (Nos. 565, 551, 72, 16, 314) there was more gas both in mannite and glucose than in maltose. These were not constant features and varied on subsequent occasions.

Agglutinations of the Strains of B. paratyphosus B isolated.—Eight strains (Nos. 106, 135, 73, 136, 159, 61, 143, 16) were tested with a specific agglutinating serum, prepared at the Wellcome Research Laboratories. The titre of this serum was stated to be 1/1,000. All the cultures were agglutinated by this serum in dilutions higher than 1/6,400.

Sixteen strains (Nos. 282, 360, 511, 547, 548, 588, 314, 518, 527, 521, 551, 565, 699, 581, 666, 735) were tested with a serum from the Lister Institute having a titre of 1/8,000. All of them were agglutinated at or above this dilution except No. 565, which was not agglutinated above 1/4,000.

Eleven strains (Nos. 734, 888, 1,081, 702, 999, 886, 842, 1,058, 1,116,

1,107, 1,118) were tested with the Royal Army Medical College serum, B₂, which had a titre of 1/10,000. Eight of these cultures were agglutinated by a dilution of 1/12,000, and three by a dilution of 1/6,000.

Agglutinating Power of Patients' own Serum upon the Bacilli isolated from their Excreta.—In seven cases (106, 73, 159, 61, 143, 16, 888) the patients' serums were not tested with emulsions of the organisms cultivated from their excreta.

In five instances (Nos. 136, 360, 666, 699, 702) the serum agglutinated an emulsion of the bacilli isolated from the excreta of the same patient in dilutions between 1/20 and 1/50.

In five cases (Nos. 581, 1,118, 1,116, 135, 282) the titre was between 1/80 and 1/200.

In nine cases (Nos. 521, 548, 1,081, 734, 735, 588, 999, 314, 1,107) cultures of the bacilli isolated were agglutinated by the corresponding serum diluted from 500 to 600 times, or more.

In eight cases (Nos. 551, 565, 547, 518, 527, 842, 886, 1,058) the patient's blood contained no agglutinins for the bacilli isolated.

Saturation Tests.—The saturation tests, of the strains of *B. paratyphosus* B isolated, were carried out in a manner similar to that employed in the investigation of strains of the "A" type. They were tested in batches of eight or ten, with three type cultures.

I am indebted to Lieutenant-Colonel D. Harvey, R.A.M.C., for two of the type cultures, "Rowlands" and "Greig," and for the other, "Netley," to Major D. Embleton, R.A.M.C.

The specific serum used was one (B₂) prepared at the Royal Army Medical College, which had a stated titre of 1/10,000, and had been obtained by immunization with strain "Rowlands."

All the strains of *B. paratyphosus* B which had been isolated from the excreta, absorbed the agglutinins for strains "Rowlands" and "Greig," but two strains, Nos. 282 and 548, did not remove the agglutinins for strain "Netley" nor for four other strains of *B. paratyphosus* B (Nos. 183, 476, 518, and 527).

Three strains of *B. aertrycke* were eliminated, by saturation tests, from amongst the cultures of *B. paratyphosus* B which had been recovered from the excreta.

Prophylactic Inoculations with Paratyphoid Vaccines.—There was evidence that 635 of the convalescents had been inoculated with a mixed typhoid-paratyphoid vaccine. This evidence was not always reliable; in more than fifteen per cent, the patient's own statement that he had been inoculated, since January, 1916, either in England or in France, was all there was to rely on; in the remainder, there was an entry to that effect in his pay-book. Paratyphoid agglutinins of both types were present in only 301 of the 635 men, and in 26 neither typhoid nor paratyphoid agglutinins were found. Absolute reliance can be placed neither on the statement of the patient nor on the entry in the pay-book. Probably the

real number of men who had been inoculated with a paratyphoid vaccine did not exceed 500, or about half the number examined. The evidence of prophylactic inoculation among those men from whose excreta paratyphoid bacilli were isolated was of the same nature. As this evidence was the same whether the men were carriers or whether they were not, the figure 635—admittedly too high—has been taken for purposes of comparison as representing the number of men who had been inoculated with a mixed vaccine.

There were five carriers of *B. paratyphosus* A; one of these was in the group of 635 who had been inoculated with a paratyphoid vaccine (0·15 per cent), and five were in the group of 365 who had received a simple typhoid vaccine only (1·37 per cent).

Fifteen carriers of *B. paratyphosus* B occurred among the 635 men who had received prophylactic inoculation with a mixed vaccine (2·36 per cent). Twenty of the 365 men who had not been inoculated with a paratyphoid vaccine were carriers (5·48 per cent).

Though the numbers were small, and the evidence not unimpeachable, the examination of this series of a thousand men showed that:—

(a) Paratyphoid carriers of the convalescent type are found among men who have received prophylactic inoculations with a paratyphoid vaccine.

(b) The percentage of such carriers was higher among the uninoculated than among the inoculated.

(c) No chronic carriers were found among the 635 men who had been inoculated with a paratyphoid vaccine, but there were seven chronic carriers among the 365 who had not.

Carriers of B. aertrycke.

Bacilli of the aertrycke group were isolated from three cases (Nos. 359; 571; 910); in one instance from the fæces, and in two from the urine. The organisms were investigated with two strains of *B. aertrycke*, namely, strain "Newport" and strain "Mutton," which were kindly supplied together with their homologous agglutinating sera, C 42 and C 38, by the Lister Institute of Preventive Medicine.

Case 359.—This patient suffered, in France, from an illness diagnosed as paratyphoid fever of the A type. His temperature had fallen to normal two weeks before his admission to this hospital. He was in fair health and his stools were formed. *B. aertrycke* was recovered in almost pure culture, from his fæces, by means of brilliant-green-peptone-water, followed by plating on lactose-litmus-agar.

He had been inoculated by the $\frac{T.V.}{1}$ method four months before his illness, and his blood-serum contained four Dryer agglutinin units in one cubic centimetre, for a standard emulsion of *B. typhosus*, but no paratyphoid agglutinins. An emulsion of the bacillus recovered from his fæces

was not agglutinated by his own blood-serum. The cultural reactions of the bacillus were those of *B. paratyphosus* B, but there was more gas produced from mannite than is usually the case with the latter organism.

An emulsion of the bacillus was agglutinated by a paratyphoid serum of the B type (titre 1 10,000, Royal Army Medical College, B₂) up to a dilution of 1/1,600. It was agglutinated by an aertrycke serum of the "Newport" strain (titre 1 12,000; Lister Institute of Preventive Medicine, C 42) up to 1/16,000. It was not agglutinated by a *B. enteritidis* serum.

Tested with several strains of *B. paratyphosus* B the agglutinins for none of them were removed from a specific serum (Royal Army Medical College, B₂) by saturation with the bacillus recovered from Case 359; when, however, an aertrycke serum of the "Newport" type was saturated with the organism under discussion, the specific agglutinins were removed. Saturation of a serum of the "Mutton" type, removed only the agglutinins for the "Newport" strain, but not those for the homologous bacillus "Mutton."

Bacillus 359 was therefore of the "Newport" type.

Case 571.—This patient was admitted from France, convalescent from dysentery of the Flexner type. He was found clear of infection within three weeks of his arrival, but some time later, while he was waiting for a vacancy to occur in a dysentery dépôt, a third examination of his excreta was made, with the result that *B. aertrycke* was found, in pure culture, in his urine. This was nineteen weeks after the commencement of his illness and when he was apparently in excellent health.

The cultural reactions of the bacillus were identical with those of *B. paratyphosus* B. It agglutinated with a paratyphoid serum of the B type (titre 1 10,000, Royal Army Medical College, B₂) at a dilution of 1/16,000. With an aertrycke serum of the "Newport" strain (titre 1/12,000, Lister Institute of Preventive Medicine, C 42) it agglutinated at 1/32,000. With a serum of the "Mutton" strain (titre 1/4,000, Lister Institute of Preventive Medicine, C₃₈) it agglutinated at 1/320. It was not agglutinated by an enteritidis (Gaertner) serum.

Tested with six strains of *B. paratyphosus* B the agglutinins for that bacillus were not removed from a specific serum by saturation with the bacillus recovered from the patient's urine.

Tested with two strains of *B. aertrycke*, "Newport" and "Mutton," the agglutinins were removed from a serum of the "Newport" strain by saturation with the bacillus under test, but when a serum of the "Mutton" strain was saturated, only the agglutinins for the "Newport" strain were absorbed, but not those of the "Mutton" type. The bacillus isolated from the urine in this case was therefore of the "Newport" type.

Case 910.—The third patient had been taken ill in France, with diarrhœa, pain in the back and aching all over the body. He said that "a rare lot in the battalion had diarrhœa at that time, so that it was very difficult to get to the latrine." During his illness a diagnosis of para-

typhoid B fever was made from the results of serum agglutination. When he was admitted to this hospital, eight weeks had elapsed since the onset of his illness, and his temperature had been normal for twelve days. The diarrhoea had ceased and he was passing formed stools.

In his pay-book it was stated that he had been inoculated in July, 1916, by the $\frac{T.V.}{2}$ method, but it is probable that T.V. had been written in error for T.A.B. His serum contained 5, 90 and 714 standard agglutinin units, respectively, for typhoid, paratyphoid A and paratyphoid B standard emulsions.

The bacillus in question was found, in pure culture, in the patient's urine, on February 22, 1917, when his temperature had been normal for two weeks.

The character of this bacillus was as follows: The cultural reactions were identical with those of *B. paratyphosus* B. It was agglutinated by paratyphoid B serum (titre 1/10,000, Royal Army Medical College, B₂) at a dilution of 1/160, when first isolated, but after it had been subcultured several times, it was agglutinated by this serum in a dilution of 1/3,000.

TABLE SHOWING THE RESULTS OF SATURATION OF A PARATYPHOID SERUM OF THE B. TYPE (ROYAL ARMY MEDICAL COLLEGE, B₂) WITH THE THREE STRAINS OF *B. aertrycke* ISOLATED, AND WITH SIX STRAINS OF *B. paratyphosus* B.

Emulsion of—	Serum after saturation with (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Unsaturated serum	* Normal saline
(1) <i>B. para.</i> B strain "Rowland's"	—	—	—	—	—	—	+	+	+	+	—
(2) " " " " "Netley"	—	—	—	—	—	—	+	+	+	+	—
(3) " " " " 567	—	—	—	—	—	—	+	+	+	+	—
(4) " " " " 651	—	—	—	—	—	—	+	+	+	+	—
(5) " " " " 693	—	—	—	—	—	—	+	+	+	+	—
(6) " " " " 888	—	—	—	—	—	—	+	+	+	+	—
(7) <i>B. aertrycke</i> strain 359	—	—	—	—	—	—	—	—	—	+	—
(8) " " " " 571	—	—	—	—	—	—	—	—	—	+	—
(9) " " " " 910	—	—	—	—	—	—	—	—	—	+	—

(Explanation of the above Table.—The agglutinating power of the serum after saturation with emulsion (1)—i.e., *B. paratyphosus* B strain "Rowland's"—was tested with each of the emulsions, 1 to 9 inclusive. The serum after saturation with emulsion (2) was tested in the same way, and so on. A positive sign indicates that agglutination took place; a negative sign indicates that none occurred.)

It was agglutinated by an *aertrycke* serum of the "Newport" strain (titre 1/12,000, Lister Institute of Preventive Medicine, C₃₈) at 1/8,000, and by a serum of the "Mutton" strain (titre 1/4,000, Lister Institute of Preventive Medicine, C₃₈) at 1/2,500. It was not agglutinated by an enteritidis (Gaertner) serum. With the patient's own serum, an emulsion

of the bacillus was agglutinated at 1/2,500; but this was only a group agglutination, for when the serum had been saturated with *B. paratyphosus* B it lost all power to agglutinate the bacillus isolated from the urine. The following were the results of saturating various specific serums with the bacillus isolated from Case 910: Tested with several cultures of *B. paratyphosus* B, the specific agglutinins were not removed from a paratyphoid serum of the B type. The agglutinins for *B. aertrycke* ("Mutton") and for the bacillus under discussion (No. 910), were absorbed from an aertrycke serum of the "Newport" type, but the specific agglutinins for the "Newport" strain itself and for the bacillus isolated from Case 571 were not removed. In the same way, saturation with the bacillus isolated from Case 910 absorbed the agglutinins for the "Newport" strain, from a serum of the "Mutton" type, but they did not remove the specific agglutinins for the "Mutton" strain.

Bacillus 910 cannot therefore be identified with either the "Newport" or the "Mutton" strain of *B. aertrycke*.

TABLE SHOWING THE RESULTS OF SATURATION OF AN AERTRYCKE SERUM OF THE "NEWPORT" TYPE (LISTER INSTITUTE OF PREVENTIVE MEDICINE, C₆₈) WITH TWO TYPE STRAINS OF *B. aertrycke* AND WITH THE THREE STRAINS ISOLATED.

Emulsion of—	Serum after saturation with (1)	Do. (2)	Do. (3)	Do. (4)	Do. (5)	Unsaturated serum	Salt-solution
(1) <i>B. aertrycke</i> strain "Newport"	—	+	—	—	+	+	—
(2) " " " "Mutton"	—	—	—	—	—	+	—
(3) ? " " " 359 ..	—	—	—	—	—	+	—
(4) ? " " " 571 ..	—	+	—	—	+	+	—
(5) ? " " " 910 ..	—	—	—	—	—	+	—

TABLE SHOWING THE RESULTS OF SATURATION OF AN AERTRYCKE SERUM OF THE "MUTTON" TYPE WITH TWO TYPE STRAINS OF *B. aertrycke* AND WITH THE THREE STRAINS ISOLATED.

Emulsion of—	Serum after saturation with (1)	Do. (2)	Do. (3)	Do. (4)	Do. (5)	Unsaturated serum	Salt-solution
(1) <i>B. aertrycke</i> strain "Newport"	—	—	—	—	—	+	—
(2) " " " "Mutton"	+	—	+	+	+	+	—
(3) ? " " " 359 ..	—	—	—	—	—	+	—
(4) ? " " " 571 ..	—	—	—	—	—	+	—
(5) ? " " " 910 ..	—	—	—	—	—	+	—

Carriers of Anomalous Organisms of the Salmonella Group.

Organisms which resembled *B. paratyphosus* B in their cultural reactions were at times very common. They were generally to be distinguished by their lack of motility, or by their power to form indol. In no case were they agglutinated, in high dilutions, by a paratyphoid serum, nor did they absorb the agglutinins specific for that bacillus.

These organisms may be classified in eight groups, according to their motility, action on dulcitol, and power to form indol in peptone-water. The presence or absence of motility and the action on dulcitol, were not observed to alter after repeated subculture. In one instance an organism which did not produce indol when first isolated, did so five months later.

It has not been practicable to prepare serums homologous for these anomalous strains, and, under the circumstances, the classification suggested above seems to be the best available.

The following reactions are common to all members of the eight groups:—

Glucose	}	Acid and gas.
Maltose		
Mannite		
Dextrin	..	Acid and a bubble of gas, later alkaline.
Milk	..	Acid, later alkaline.
Gelatine	..	Not liquefied.

This table shows the scheme of classification suggested:—

A.—Motile	{	Dulcitol; acid and gas	{	Indol formed	..	Group (i)
			{	No indol	..	Group (ii)
	{	Dulcitol; no change	{	Indol formed	..	Group (iii)
			{	No indol	..	Group (iv)
B.—Non-motile	{	Dulcitol; acid and gas	{	Indol formed	..	Group (v)
			{	No indol	..	Group (vi)
	{	Dulcitol; no change	{	Indol formed	..	Group (vii)
			{	No indol	..	Group (viii)

Apart from paratyphoid and aertrycke organisms, members of the first four—that is, the motile groups—were very rare and were met with only four times. All the organisms belonging to Group (ii) were identified either with *B. paratyphosus* B or with *B. aertrycke*, that is to say, they were agglutinated in high dilutions with either a paratyphoid or an aertrycke serum. One strain was encountered which did not absorb the specific agglutinins from either the “Newport” or “Mutton” type serum, though it was agglutinated by the former in high dilutions.

Two strains were isolated which belonged to Group (i); one strain which belonged to Group (iii) and one which belonged to Group (iv).

Members of the non-motile groups which formed indol (i.e., Group (v) and Group (vii)) were met with frequently. Sometimes those belonging to one or other of these groups would be isolated from large numbers of the specimens examined during a period of several weeks, and then there would be an interval of perhaps a month, during which they would appear

very seldom or not at all. Sometimes one group was predominant and sometimes the other.

No one who has been engaged in the bacteriological examination of the excreta, for any length of time, can fail to have been struck by the sudden appearance of some organism which, for a time, is present in a large number of specimens and then, perhaps, disappears as suddenly as it came. In the summer of 1916, organisms with the cultural reactions of *B. morgan* I, were isolated frequently, but since then they have not been met with in large numbers. The flora of the intestine is subject to striking variations; Major Clemesha has written ("The Bacteriology of Surface Waters in the Tropics"): "We wish to lay stress on the fact that experience has shown that there are epidemics of certain organisms in the fæces of both man and animals."

Only four strains were isolated which belonged to Group vi, the members of which are non-motile and ferment dulcitol, but do not produce indol. These four organisms were all met with during one week.

No organisms belonging to Group viii (non-motile organisms which do not ferment dulcitol and do not produce indol) were encountered.

IV.—CARRIERS OF INFECTIONS OF THE FEBERTH GROUP.

Carriers of B. typhosus.

B. typhosus was isolated from the excreta of eight patients. In one instance (No. 264) from both fæces and urine; in two (Nos. 291, 301) from the fæces only, and in five (Nos. 360, 519, 526, 560, 74) from the urine only. Two of the patients (Nos. 264, 560) had come from the East, the remainder from France.

The diseases from which these eight patients had suffered had been diagnosed as typhoid in one instance, as "enteric" in three, and as "paratyphoid" in four.

Six of the eight were over 30 years of age, the average age being 32 years. (The average age of the men in whose excreta *B. paratyphosus* A was found was 27 years, and of the patients with *B. paratyphosus* B, 25 years.)

All of them were convalescent carriers, and in every case the infection cleared up before they left the hospital. None was a chronic carrier. For the most part they were sent here at the end of an attack of typhoid fever, very soon after the temperature had reached normal, and they were still weak and debilitated. Typhoid bacilli were isolated from their excreta for the first few days after their arrival and then disappeared altogether. The following is a short account of the patients from whose excreta the bacillus was isolated:—

No. 264 was admitted in a dazed condition with a history of fever of four weeks duration. He had a healed trephine-scar in the upper part of the forehead, due to a gunshot wound received five months before.

B. typhosus was recovered on a single occasion from the fæces in the fifth week, and once from the urine in the sixth week after the commencement of his fever. The bacillus was not found again in fourteen subsequent examinations of the fæces and urine made during the next four weeks.

Nos. 291 and 301 were "cot cases" admitted in the fifth week after the onset of illness. *B. typhosus* was isolated from the fæces of each of them at the first examination, but not at the second, which was made four days later. Both were then transferred to another hospital.

No. 360 was fairly strong and able to walk about. *B. typhosus* was isolated from his urine on three consecutive occasions in the tenth week after the beginning of his illness, when he was feeling perfectly well and strong. The bacillus was not found again in nine examinations made during the next four weeks. This man was the only apparently healthy person from whose excreta *B. typhosus* was recovered.

No. 519 was admitted as a "cot case" three weeks after his illness began. His temperature was normal, but he complained of abdominal pain. *B. typhosus* was isolated once from his urine during the week of his admission, but not again in nine examinations made during the next four weeks.

No. 526 was also admitted as a "cot case," complaining of weakness and headache. His temperature was normal. *B. typhosus* was found in his urine on four consecutive occasions during the thirteenth week, but not again in sixteen subsequent examinations extending over a period of four weeks.

No. 560.—This patient was weak and anæmic when he was admitted. He had been taken ill in the East, twenty weeks before. The diagnosis on his transfer certificate was "malaria and enteric." *B. typhosus* was found in his urine at the first of eleven examinations made in the four weeks following his admission to this hospital.

No. 740.—This man's temperature had fallen to normal, ten days before his admission, but he was still weak and ill. *B. typhosus* was found in his urine, at each of six examinations made during the ninth, tenth and eleventh weeks after the beginning of his illness. It then disappeared from the urine, and was not found at twelve examinations made during the next four weeks.

Prophylactic Inoculations and the Agglutinin Content of Patients' Serum.—Six patients (Nos. 264, 291, 301, 360, 526, 560) had been inoculated with a typhoid vaccine (by the $\frac{T.V.}{2}$ method) from eight to sixteen months before the commencement of illness. Except in one case (No. 360), where there was only the man's own statement to rely on, there was evidence to this effect in the men's pay-books. The other two patients (Nos. 519, 740) had been inoculated with a mixed typhoid and paratyphoid vaccine ($\frac{T.A.B.}{2}$); the first, two months and the second, five months before he became ill.

The agglutinin content in one case (No. 526) was as high as 10,000 units, in another (No. 301) no typhoid agglutinins were present. The average quantity of typhoid agglutinins in the other six cases was 229 units.

The serum of none of these eight men contained agglutinins for *B. paratyphosus* A, and the serum of one only (No. 519), a man who had been inoculated with a mixed vaccine, contained agglutinins for *B. paratyphosus* B.

The following table shows the type of prophylactic inoculation and the agglutinin content of the serum in these eight cases.

TABLE SHOWING TYPE OF INOCULATION AND AGGLUTININ CONTENT OF CARRIERS OF *B. typhosus*.

Number	Inoculation	Standard agglutinin units in 1 c.c.		
		Typhoid	Para A	Para B
264	T.V. 2	312	0	0
291	T.V. 2	624	0	0
301	T.V. 2	0	0	0
360	T.V. 2 (own statement)	39	0	0
519	T.A.B. 2	215	0	73
526	T.V. 2	10,000	0	0
560	T.V. 2	43	0	0
740	T.A.B. 2	106	0	0

Cultural Reactions of the Strains of B. typhosus isolated.—All the strains, in their growth, behaved according to type. They were all motile, none of them produced indol, and they all formed acid in glucose, maltose, mannite, dextrin and milk.

In dulcete, dextrin and milk there were minor differences in their behaviour. Acid was formed in dulcete on the fourteenth day by strain No. 360, but not by any others. Strain No. 526 reversed its first action on dextrin, and, on the eighth day, turned it alkaline again. Strains 360, 519, 301 and 740 did the same between the tenth and sixteenth days. In the other three cases dextrin remained acid. In three cases (Nos. 560, 519, 301) milk became alkaline at the end of the second week, and in two others (Nos. 264, 296) at the beginning of the third week. In three cases it remained acid.

Agglutination with Specific Serums.—The agglutination reactions of the strains of *B. typhosus* isolated were carried out, in seven instances, with a specific serum obtained from the Lister Institute, and in one with a serum from the Royal Army Medical College. The stated titre of both serums was 1/8,000.

In five cases (Nos. 264, 291, 301, 560, 519), the limit of agglutination was between 1/5,000 and 1/10,000. In three cases (Nos. 360, 526, 740) agglutination occurred in dilution as high as 1/12,000.

The following table shows the highest dilution of the blood-serum of each patient which agglutinated the organism recovered from his excreta :—

AGGLUTINATING POWER OF THE PATIENTS' SERUMS UPON THE TYPHOID BACILLI ISOLATED FROM THEIR EXCRETA.

No.						End titre of patient's own serum, which agglutinated the bacillus recovered from his excreta
264	..	..	..	..	..	1/12,800
291	..	..	..	..	..	1/320
301	..	..	..	..	..	0
360	..	..	..	..	..	1/80
519	..	..	..	..	..	1/160
526	..	..	..	..	..	1/320
560	..	..	..	..	..	1/160
740	..	..	..	..	..	1/640

It will be noted that in Case 301 the serum did not agglutinate the bacillus isolated from this man's fæces. In this instance *B. typhosus* was cultivated from the fæces at the first examination but not at the second. The patient was then transferred to another hospital. His blood-serum, as stated before, contained no agglutinins for a standard emulsion of typhoid bacilli.

Absorption Tests.—These were carried out in a manner similar to that employed in the examination of the different strains of *B. paratyphosus* A.

A culture of *B. typhosus* obtained from the Lister Institute, and another kindly given me by Major Embleton, of the Royal Victoria Hospital, Netley, were used as types. The serum employed was one prepared at the Royal Army Medical College (T₂), with a titre of 1 10,000. The specific agglutinins were removed from this serum by all of the eight strains of *B. typhosus* isolated.

Carriers of B. dysenteriae (Shiga).

Only one carrier of the Shiga type of dysentery was detected (Case 886). This patient came from France, convalescent from an attack of dysentery which had begun five weeks before. He had suffered from a previous attack, one and a half years before, in the Eastern Mediterranean. When admitted to this hospital he still had slight diarrhœa and occasional pains in his abdomen.

B. dysenteriae (Shiga) was isolated from his fæces on February 23, 1917, five weeks after the beginning of his illness, by direct plating on Endo's medium. On that occasion the Shiga colonies formed about 2 per cent of all those on the plate. Subsequent examinations proved negative until eleven days later when there were 40 per cent of Shiga colonies present. Four days later, on March 10, the result was again positive, and thereafter the bacillus was frequently recovered from his fæces, sometimes in pure culture. His excreta have been examined sixty-one times since March 22, 1917, and *B. dysenteriae* (Shiga) has been isolated on thirty-five occasions; he is now in the seventeenth week and is still a carrier. The bacillus

isolated gave the typical cultural reactions of classical *B. dysenteriae* (Shiga). It was agglutinated by a serum of the Shiga type (titre 1/1,500 Lister Institute, D 31) in a dilution of 1/2,560, and when this serum was saturated with the bacillus the specific agglutinins for *B. dysenteriae* (Shiga) were absorbed. The patient's own serum agglutinated the bacillus in a dilution of 1/400.

Bacilli which had the cultural reactions of Shiga's bacillus were isolated from the faeces of several other convalescents, but these organisms were agglutinated, either not at all or only in low dilutions, by a specific serum, and in no case did they absorb the specific agglutinins from it.

Carriers of B. dysenteriae (Mannite-fermenting).

Dysentery bacilli of the mannite-fermenting group were isolated from the faeces of eighteen patients, all of whom came from France and had never been in the East.

When these organisms were isolated, on an average not more than four and a half weeks had passed since the commencement of illness, and, in half the cases, the men were still passing loose motions. In no case were mannite-fermenting dysentery bacilli isolated more than nine weeks after the beginning of the attack, and in only one instance were they found after the fifth week.

The examination of each patient extended over a period of four weeks after the faeces were found to contain dysentery bacilli, and on an average eleven specimens were examined in every case.

Mannite-fermenting dysentery bacilli were isolated from the faeces at the first examination in twelve cases, at the second in four, and not until the third in two. In only three cases were they found on more than one occasion. The organisms which were isolated were according to type in only one of the eighteen cases, No. 794. None of them was agglutinated to the end titre of the specific serums of the Flexner and Y types, which were employed in testing them.

Possibly few or none of these organisms were pathogenic. On the other hand, all but two of the patients in whom they were found were in early convalescence from dysentery, and, as they recovered, the organisms quickly disappeared from their excreta. Moreover, all the strains were agglutinated by low dilutions of serums specific for type strains of mannite-fermenting organisms and also, in most instances, by the patient's own blood-serum, in dilutions between 1/20 and 1/80.

In every case the bacillus was recovered from the faeces by direct plating on Endo's medium; in none was it isolated after brilliant-green enrichment. As direct plating was not employed in the examination in the first 200 cases, and no dysentery bacilli were isolated during that period, these cases should be omitted in calculating the percentage of carriers of mannite-fermenting organisms; all the eighteen cases occurred

amongst the 800 men who were examined by direct plating as well as by brilliant-green enrichment—i.e., 2.25 per cent. Most of the organisms which were isolated were more nearly related to the Y type than to the Flexner type.

One strain, No. 1033, fermented saccharose, maltose, and dextrin in first subcultures. This was the only one which fermented maltose when first isolated; two others, Nos. 206 and 479, acquired that power three months later, and six more, Nos. 206, 441, 479, 697, 794, and 1057, were able to ferment dextrin after frequent subcultivation. The power of producing indol varied; sometimes it was present at first, and lost or delayed later; sometimes it was absent at first and acquired afterwards. Five strains, Nos. 479, 697, 1033, 1051, 1058, did not produce indol.

The cultural reactions of the different strains isolated are set out in the following table:—

TABLE OF CULTURAL REACTIONS OF MANNITE-FERMENTING ORGANISMS ISOLATED.

Case No.	Lac-tose	Sac-charose	Glu-cose	Mal-tose	Man-nite	Dextrin	Dul-cite	Milk	Motility	Indol	Gela-tine
206	—	—	A	A	A	A : K	—	A : K	0	+	0
430	—	—	A	—	A	—	—	A : K	0	+	0
441	—	—	A	—	A	A : K	—	A : K	0	+	0
479	—	—	A	A	A	A	—	A : K	0	0	0
465	—	—	A	—	A	—	—	A : K	0	+	0
702	—	—	A	—	A	—	—	A : K	0	+	0
697	—	—	A	—	A	A	—	A : K	0	0	0
794	—	—	A	—	A	A : K	—	A : K	0	+	0
973	—	—	A	—	A	—	—	A : K	0	+	0
1033	—	A	A	A	A	A	—	A : K	0	0	0
1039	—	—	A	—	A	—	—	A : K	0	+	0
1078	—	—	A	—	A	—	—	A : K	0	+	0
1048	—	—	A	—	A	—	—	A : K	0	+	0
1051	—	—	A	—	A	A	—	A : K	0	0	0
1079	—	—	A	—	A	—	—	A : K	0	+	0
1058	—	—	A	—	A	—	—	A : K	0	0	0
1087	—	—	A	—	A	—	—	A : K	0	+	0
1147	—	—	A	—	A	—	—	A : K	0	+	0

+ = Liquefaction, or indol formation.
 — = No change.
 A = Acid.
 K = Alkaline.
 0 = { No liquefaction, or
 { No indol, or
 { Non-motile.

Two specific serums were employed for investigating the reactions of these organisms: a serum of the Flexner type (D.F.i), with a titre of 1/4,000 and a serum of the Y type (Y₂) with a titre of 1/500; both had been prepared at the Royal Army Medical College.

Two strains, only, were agglutinated by the Flexner serum in dilutions as high as 1/1,200. No strains were agglutinated by the Y serum diluted

above 1,400. The following table shows the limit of agglutination of each strain by the two serums. For purposes of comparison the highest dilution of the Flexner serum which produced agglutination has been divided by eight, as its titre was eight times that of the Y serum.

TABLE OF AGGLUTINATION OF MANNITE-FERMENTING STRAINS ISOLATED.

Case No.	Agglutination with Flexner serum	Agglutination with "Y" serum
206 ..	0	1/160
430 ..	1/10	1/140
441 ..	1/40	1/320
479 ..	1/40	1/160
465 ..	1/80	1/160
702 ..	1/20	1/400
697 ..	1/160	1/80
794 ..	1/10	1/400
973 ..	1/20	1/160
1,033 ..	1/30	1/160
1,039 ..	1/80	1/400
1,078 ..	1/10	1/160
1,048 ..	1/20	1/80
1,051 ..	1/160	1/160
1,079 ..	1/10	1/40
1,058 ..	1/20	1/160
1,087 ..	1/10	1/40
1,147 ..	1/20	1/400

When serums of the Flexner and Y types were saturated with emulsions of the mannite-fermenting organisms which had been isolated, the specific agglutinins were removed by one strain only, No. 794, from the Y serum. None of the cultures absorbed the specific agglutinins from the Flexner type serum. The serums employed in the saturation tests were the same as those used for agglutination. The type strains of *B. dysenteriae* were kindly supplied by the Lister Institute.

V.—CARRIERS OF MIXED BACILLARY INFECTIONS.

Persons who were carriers of more than one pathogenic organism, at one and the same time, were met with on three occasions. One was a chronic carrier of *B. paratyphosus* B and *B. paratyphosus* A; the second was a carrier of *B. paratyphosus* B and an atypical mannite-fermenting dysentery organism; the third was a carrier of *B. paratyphosus* B and *B. dysenteriae* (Shiga).

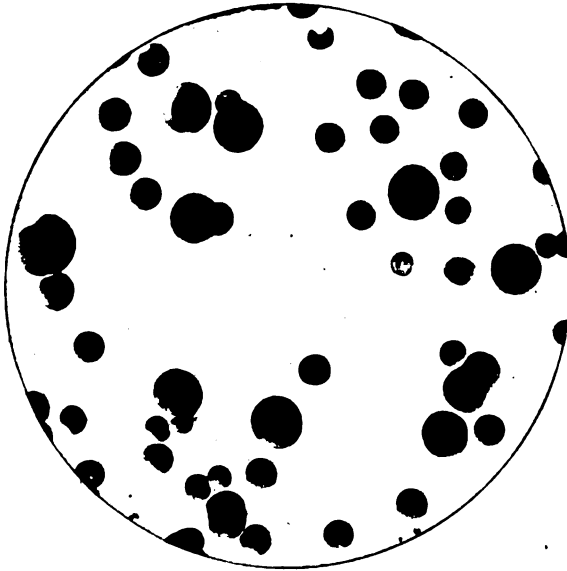
The first case (No. 666) was a chronic faecal carrier of *B. paratyphosus* A and *B. paratyphosus* B. His illness, which was diagnosed as dysentery, commenced about September 1, 1916, in Salonica. Three weeks later, when he was getting better, his temperature suddenly went up again, and he had a severe illness. He recovered, and had been getting up for three weeks, when he was admitted to this hospital, on December 22, 1916, with the diagnosis on his transfer certificate of "Dysentery and Para. B fever."

When an examination of his excreta was made, a few days after his arrival, there were two types of colonies, a large and a small type, on the Endo plate employed. It was found on subcultivation that the larger type

of colony consisted of *B. paratyphosus* B, and the smaller of *B. paratyphosus* A.

On Endo's medium, the "B" colonies, besides being large and slightly granular, were more pink in colour than the smaller, more compact, bluish-white "A" colonies.

The accompanying photograph of a twenty-four hour culture on Endo's medium shows the relative size of the two types of colonies.



PHOTOGRAPH OF ENDO PLATE FROM FÆCES OF No. 666 ($\times 5$).

The large colonies are *B. paratyphosus* B.
The smaller colonies are *B. paratyphosus* A.

The fæces were examined a hundred times between December 22, 1916, and May 8, of the following year, and on almost every occasion paratyphoid bacilli of both types were found to be present. When an emulsion of the fæces, in salt-solution, was plated direct on to Endo's medium, as a rule, some seventy per cent of the colonies consisted of paratyphoid bacilli. Usually, the number of paratyphoid A and paratyphoid B colonies was approximately equal; sometimes there was a tendency for one type, generally B, to predominate.

The cultural reactions of the smaller type of colony were those of *B. paratyphosus* A; the larger colonies gave the reactions of *B. paratyphosus* B.

Subcultures of the smaller colonies were agglutinated by a paratyphoid serum of the A type, prepared at the Lister Institute (which had a stated titre of 1/8,000), in as high a dilution as 1/16,000. This organism also absorbed the specific agglutinins from the same serum.

Subcultures of the larger colonies were agglutinated at 1/8,000 by a serum of the "B" type, with a stated titre of 1/8,000 and emulsions of them absorbed the agglutinins specific for *B. paratyphosus* B.

It is uncertain whether this patient had been inoculated with a paratyphoid vaccine. According to his own statement, he had received two protective inoculations in May, 1915, and again two in July, 1916. The July inoculations may have been made with a mixed typhoid and paratyphoid vaccine, or with a cholera vaccine; the latter is more probable.

His blood serum contained 43, 120 and 20 standard agglutinin units per one cubic centimetre for *B. typhosus*, *B. paratyphosus* A, and *B. paratyphosus* B, respectively. It agglutinated the "A" type bacilli recovered from his fæces, up to a dilution of 1/320, and the "B" type at 1/20.

From his admission in December to the present time, five months later, he has always looked in robust health, and has never suffered from any pains in the stomach or from diarrhœa.

In the hope of ridding him of the infection, he was given milk, clotted by a culture of *B. coli* which appeared to have overgrown an infection of *B. paratyphosus* in another patient. There was some improvement while he was taking the milk, but unfortunately one day the flask containing the clotted milk was broken, so that it became necessary, in order to carry on the strain, to resort to an old culture of the bacillus on agar. The organism never regained its full power of clotting milk, and the milk, inoculated with it, had no beneficial effect.

Subsequently, milk clotted with a strain of *B. bulgaricus*, obtained from a firm of chemists, was administered without producing any improvement.

A lactic-acid fermenting streptococcus obtained from the Royal Army Medical College was also employed, but no good effects resulted from its use.

A mixed vaccine was made from the two types of paratyphoid organisms recovered from his fæces, and he received this, in doses of two thousand million every eight days, for a period of seven weeks, but no improvement followed.

The second patient, No. 702, was a temporary carrier of an atypical dysentery organism of the mannite-fermenting type, and also of *B. paratyphosus* B.

His illness began in France on December 27, 1916, with diarrhœa and the passing of blood and slime. When he was admitted to this hospital, in the third week, the diarrhœa had not stopped. No rise of temperature was recorded during the whole course of his illness.

Between January 10 and 30 ten examinations of his fæces were made, with the result that mannite-fermenting organisms were isolated four times and *B. paratyphosus* B on six occasions.

The third patient, No. 886, was a carrier of *B. dysenteriae* of the Shiga type.

He had been under examination for many weeks, *B. dysenteriae* being

almost constantly present, and thirty-nine specimens of his fæces had been examined, when both *B. dysenteriae* (Shiga) and *B. paratyphosus* B were isolated from a sample examined on April 14 in the twelfth week after the beginning of his illness.

Between April 14 and the present time, three weeks later, *B. dysenteriae* has been isolated from this patient's stools on seven occasions, and *B. paratyphosus* B nine times.

More than three months have elapsed since the commencement of this patient's attack of dysentery. He is, therefore, according to Sacquépée's classification, a *porteur chronique* of *B. dysenteriae*. With reference to his infection with *B. paratyphosus* B, he appears to be in quite a different category, and is probably a *porteur précoc*e of that organism. His case has already been discussed from that point of view in connection with carriers of *B. paratyphosus* B.

VI.—THE VITALITY OF THE PATHOGENIC ORGANISM IN THE FÆCES OF PARATYPHOID CARRIERS.

The pathogenic organisms in the fæces of at least some chronic paratyphoid carriers exhibit an extraordinary vitality; this may be due to their own robust nature, or it may be because they are present in such vast numbers and have the mastery over the competing organisms in the excreta. The following experiments were carried out with the fæces of chronic carriers of paratyphoid organisms of both types.

(1) A dozen sterile diphtheria swabs were plunged into the fæces of Case 666, a chronic carrier of a mixed infection of paratyphoid of both type "A" and type "B." The swabs were kept at 15° C., and one of them was plated on Endo's medium each day. After the fifth day no red colonies appeared on the plates. Paratyphoid organisms were present in small numbers up to the tenth day. The swabs were then dry, and no colonies grew on Endo's medium inoculated from them.

(2) The same experiment was repeated but the swabs were kept in the incubator at 37° C. They were sterile, for Endo plating, after four days.

(3) One gramme of fæces, from the same patient, was emulsified in ten cubic centimetres of sterile, salt-solution and kept at room temperature. As the laboratory is heated by hot water this has rarely fallen below 15° C., though it is sometimes as high as 20° C.

For many weeks the emulsion was examined every day, but latterly the examinations were made weekly. Both *B. paratyphosus* A and *B. paratyphosus* B were cultivated from this emulsion after a hundred days.

(4) One gramme of fæces from the same patient was emulsified and examined in the same way, but ordinary, unsterilized tap-water was used instead of sterile salt-solution. Both types of organisms flourished for

fifty-nine days, after which those of the "A" type perished, but "B" type organisms are still present after ninety-six days.

(5) A mass of fæces from Case 666, weighing about fifty grammes, was kept at room temperature in a glass vaseline-pot with a screw top; *B. paratyphosus* A died out, but *B. paratyphosus* B could still be isolated from it on the forty-first day, though the material was buried in a profuse growth of moulds.

(6) The fæces of another carrier of *B. paratyphosus* B (No. 735) were emulsified in the same way in ordinary tap-water, not sterilized. The organisms could still be isolated from the emulsion after eighty days.

(7) In a similar experiment made with the fæces of a chronic carrier (No. 782) of paratyphoid organisms of the "A" type emulsified in salt-solution, the organisms could be recovered up to the twenty-fifth day, but not afterwards.

(8) The fæces of the same patient were emulsified with ordinary tap-water, in place of sterile salt solution. *B. paratyphosus* A was still present on the fifty-first day.

(9) An emulsion of the fæces of No. 666 (the carrier of a mixed infection of paratyphoid organisms of both types) was made in salt-solution kept at 37° C. in the incubator and examined daily. *B. paratyphosus* A could not be cultivated from the emulsion later than the ninth day. After the tenth day all the lactose-fermenting bacilli had disappeared, and the result of direct plating on Endo's medium was a pure culture of *B. paratyphosus* B. A few of the latter organisms could be cultivated as late as the fifteenth day. After this date, Endo plates inoculated from the emulsion remained sterile. The emulsion was well shaken and plated on trypsin-agar; the result was that colonies of streptococci appeared after twenty-four hours, but they were not in large numbers. All coliform organisms had disappeared.

The long periods during which paratyphoid bacilli can persist in emulsions, made from samples of the fæces of chronic carriers of massive infections, explains, to some extent, the difficulty of curing them.

As a control to the above experiments, similar emulsions were made from the fæces of five convalescent carriers of *B. paratyphosus* B. These emulsions were kept at room temperature and examined daily. After eight days had elapsed the pathogenic organisms could no longer be recovered from three of them, but they were isolated from the two others up to twenty days, but not later.

In none of these five cases were the pathogenic organisms as numerous as in the excreta of the chronic carriers, so that the comparison between them is not altogether a fair one, but the results of the foregoing experiments indicate that it may be possible to decide from the vitality of the pathogenic organisms in an emulsion of the fæces, whether a patient be a carrier of the convalescent type, or whether he will become a chronic carrier.

VII.—THE TREATMENT OF BACILLARY CARRIERS.

With a view to eliminating the pathogenic organisms two classes of treatment were adopted:—

- (1) Treatment with autogenous vaccines.
- (2) Treatment by feeding on cultures of lactose-fermenting organisms, in milk or in other media.

(1) *Treatment with Autogenous Vaccines.*

No success has attended this method. One patient, a chronic carrier of both types of paratyphoid bacilli, was treated with an autogenous vaccine for seven weeks, during which many thousand millions of *B. paratyphosus* A and of *B. paratyphosus* B were injected. No improvement occurred, and it is to be remarked that the agglutinin content of his serum was increased but slightly for *B. paratyphosus* B (fifteen units only) and not at all for *B. paratyphosus* A.

A chronic carrier of *B. dysenteriae* (Shiga) was treated with an autogenous, sensitized vaccine. He was given a dose of five hundred millions bacilli weekly for three weeks, and then 1,000 millions every eight days. For ten days no dysentery organisms were isolated from his faeces, but at the end of that time they reappeared.

(2) *Feeding with Cultures of Lactose-fermenting Organisms.*

Two types of organisms were employed: (a) bacilli, (b) cocci.

(a) *Bacillary Cultures.*—Five chronic carriers were treated with milk, inoculated with a non-saccharose-fermenting culture of *B. coli*, which had been isolated from a man who was convalescent from paratyphoid fever, and which overgrew the pathogenic organisms in his excreta as the infection gradually disappeared. This bacillus clotted milk in twelve hours.

The results were, at first, encouraging, but after ten days or so, as mentioned before, the flask containing the clotted milk was broken, and it became necessary to have recourse to a stock-culture which had been growing on agar for two weeks or more. The bacillus never regained its full power of clotting milk, and it was useless in effecting a cure of the carriers.

A culture of a large Gram-negative bacillus, originally obtained under the name of *B. bulgaricus*, from a firm of chemists, and which also clotted milk within twelve hours, was employed without any good results.

(b) *Streptococcal Cultures.*—Four cases have been treated with Professor Emil Westergaard's lactic-acid streptococcus, a culture of which was obtained from the Royal Army Medical College. It grows readily upon ordinary nutrient-agar, and forms short chains in broth; it produces acid in lactose, glucose, and maltose, and clots milk within twenty-four hours. It forms acid in mannite after about four days.

The oatmeal-yeast-lactose medium was prepared and inoculated with the streptococcus, as directed by Professor Westergaard.

No acute cases of dysentery were available for treatment, so the four following cases were selected, and each of them was given half a pint of the culture three times a day.

- (a) A carrier of a mannite-fermenting dysentery bacillus.
- (b) A carrier of *B. dysenteriae* of the Shiga type.
- (c) A patient with chronic dysentery, from whom no pathogenic organisms had been isolated for many months.
- (d) A chronic carrier of *B. paratyphosus* of both the "A" and "B" types.

All the patients were getting up and walking about, but none of them except (d) was in really good health.

The first patient (Case a) was taken ill in France, and admitted to this hospital two weeks later, when he was convalescent. He still had diarrhoea, and was passing five or six thin, watery stools, daily. Atypical mannite-fermenting dysentery bacilli were isolated from his faeces once in the second week, three times in the third week, and once at the beginning of the fourth week, when the treatment was commenced.

The treatment was continued for ten days. During that time the diarrhoea did not improve, and the stools remained watery. Mannite-fermenting organisms were still isolated after the treatment had been commenced four days, but were not found afterwards in twenty-eight subsequent examinations.

There was no improvement in this man's diarrhoea or general condition. Though dysentery organisms were not found in his faeces later than the fourth week after the beginning of his illness, this disappearance may or may not have been due to the ingestion of the streptococcal culture. In only one of eighteen convalescents, from whose faeces mannite-fermenting organisms were recovered, were they isolated later than the fifth week, so that it is probable that in this instance, too, they would have disappeared without the help of the streptococcal culture.

The second patient (Case b) was a carrier of *B. dysenteriae* (Shiga), whose illness had commenced ten weeks before. *B. dysenteriae* (Shiga) had been isolated from his faeces seventeen times, between the date of his admission in the fifth week of his illness and the date on which the treatment was commenced in the tenth week. The day before he received his first dose of the broth, "Shiga" colonies formed seventy per cent of those which grew on a plate of Endo's medium spread with an emulsion of his faeces.

When he was admitted to this hospital, he was passing five or six fluid motions daily. The stools contained a large amount of pus, but this consisted of small cells, and no *Entamoeba* could be found.

The treatment was continued for fourteen days, but during that time the character and number of the stools underwent no change. The faeces

were plated daily, and on every occasion *B. dysenteriae* (Shiga) was found to be present. Five weeks later, when he was transferred to another hospital, he was still a carrier.

The third patient (Case *c*) had been suffering from diarrhoea for eight months or more. On one occasion, while he was in Egypt, *B. dysenteriae* (Shiga) had been isolated from his stools, but since then no bacterial or protozoal infection had been discovered. His bowels were open about ten times every day; the stools were partly formed and partly fluid, they always contained pus.

He was given the broth culture of streptococci for fourteen days. His motions became less frequent, five instead of ten, but they still contained pus.

The fourth patient (Case *d*) was a chronic carrier of *B. paratyphosus* A and B. Thirty-five weeks had passed since he was first taken ill, but both type "A" and type "B" organisms were constantly present in his fæces. Apart from the fact that he was a carrier of pathogenic organisms, he was in excellent health. He was given the broth culture for fourteen days. During the time he was taking it, and during the five weeks which have elapsed since, pathogenic organisms were isolated at every examination.

In order to investigate the influence of Professor Westergaard's streptococcus upon the growth of pathogenic organisms, a series of experiments was conducted, *in vitro*, with emulsions of the excreta of chronic carriers, and for this purpose the fæces of Cases *b* and *d*, carriers of *B. dysenteriae* (Shiga) and *B. paratyphosus*, respectively, were emulsified in cultures of the streptococcus.

(1) One gramme of the fæces of Case *b*, the carrier of *B. dysenteriae* (Shiga), was emulsified in ten cubic centimetres of lactose-peptone water, containing a little calcium carbonate. A second gramme was emulsified in the same quantity of the same medium, with the difference that it had been inoculated, the day before, with a culture of the streptococcus.

The tubes were kept at room temperature (15° to 18° C.), and examined daily. *B. dysenteriae* (Shiga) could not be cultivated from the emulsion made in the sterile medium, after the second day. It was cultivated from the tube containing the culture of the streptococcus on the sixth day, but not later.

(2) Ten cubic centimetres of the yeast-oatmeal-broth, to which lactose had been added, but which had not been inoculated with the streptococcus, was put into a test-tube, and one gramme of the fæces of Case *b* was emulsified in it.

A similar emulsion was made in a second tube, but in this case the broth had been inoculated with the streptococcus twenty-four hours before, so that it was in the condition in which it is fed to the patients.

B. dysenteriae was not cultivated from the emulsion made in the sterile broth later than the fourth day, but it was cultivated from the broth inoculated with the streptococcal culture, on the fourteenth day.

(3) Similar experiments were carried out with the fæces of Case *c* the chronic paratyphoid carrier, with the result that paratyphoid bacilli were cultivated from the fæcal emulsion made in sterile lactose-peptone water, up to the eighteenth day, and from a similar emulsion containing a culture of the streptococcus up to the twenty-first day.

(4) Paratyphoid bacilli were cultivated from the emulsion of the fæces of Case *c* made in sterile yeast-oatmeal-lactose-broth up to the thirteenth day, and from a similar emulsion in broth containing the streptococcus up to the fifteenth day.

The above experiments do not show that the presence of the streptococcus was prejudicial to the growth of *B. dysenteriae* (Shiga) or to paratyphoid organisms, but it is to be noted that they were conducted at room temperature, 15° C. to 18° C., and not at 25° C., which is said to be the optimum temperature for the growth of the streptococcus.

The results of treatment by means of autogenous vaccines, and by feeding with cultures have been disappointing. There was no evidence, from the results obtained in the limited number of cases treated in this hospital, that the administration of a yeast-oatmeal-lactose-broth culture of Professor Westergaard's streptococcus exercised a beneficial effect upon carriers of *B. dysenteriae*, of the "Shiga" or "Y" groups, or upon carriers of *B. paratyphosus* of the "A" or "B" types.

VIII.—SUMMARY AND CONCLUSIONS.

(1) *Brilliant-green Enrichment and the use of Telluric Acid.*

(a) The employment of brilliant-green is of the greatest value in the detection of carriers of organisms belonging to the Gaertner group.

(b) When brilliant-green enrichment is used, it is imperative that, in addition, plates be spread direct from the excreta; because brilliant-green exerts an inhibitory influence upon the growth of organisms belonging to the Eberth group. If the brilliant-green method be employed alone, infections of the Eberth group will be overlooked; if direct plating be employed alone, infections of the Gaertner group will be missed. Both methods should be used.

(c) The samples of telluric acid, employed in this laboratory, inhibited the growth of paratyphoid and dysentery organisms.

(2) *Carriers of B. paratyphosus A.*

(a) *B. paratyphosus A* was isolated from the excreta of six convalescents, i.e., 0.6 per cent; in one case it was recovered from the urine, and in five from the fæces.

(b) Five of the six carriers were found among the 154 men who had served in the East, but only one among the 846 who came from France.

(c) Three of the men were convalescent carriers and three were chronic carriers; two of the latter are known to have been carriers before the war.

(d) One man had been inoculated by the T.A.B. 2 method, with a mixed typhoid and paratyphoid vaccine, four months before he was taken ill; the other five had been inoculated with a simple typhoid vaccine.

(e) The organisms were found at the examination of the first specimen, in each of the six cases.

(f) "Pseudo-paratyphoid A" bacilli were not met with.

(g) Judging from the results of the examination of 846 convalescents from France, paratyphoid fever of the "A" type was of rare occurrence in that country during 1916-17.

(3) *Carriers of B. paratyphosus B.*

(a) *B. paratyphosus B* was isolated from the excreta of 35 convalescents, i.e., 3.5 per cent. In 9 cases the organisms were isolated from the urine, and in 26 from the faeces.

(b) Six of these men had been in the East, the remaining 29 were from France.

(c) *B. paratyphosus B* was isolated on one or two occasions in 20 cases; repeatedly, before its disappearance, in 7 cases; later than three months after attack, and up to date of transfer, in 5 cases; during the incubation stage in 3 cases. Total, 35 cases.

(d) *B. paratyphosus B* was isolated at the first examination in 25 cases; at the second examination in 5 cases; at the third examination in 2 cases; during incubation in 3 cases.

(e) Fifteen of the patients, from whose faeces *B. paratyphosus B* was isolated, had been inoculated with a mixed vaccine of typhoid and paratyphoid organisms. None of the five chronic carriers had received a prophylactic inoculation with a paratyphoid vaccine.

(f) Three precocious carriers of *B. paratyphosus B* were met with. People who become infected with paratyphoid fever may disseminate the germs of the disease during the stage of incubation while they yet appear to be in their usual state of health.

(g) A general infection of the body with paratyphoid organisms may occur, without any rise of pulse-rate or temperature, and, without visible effect upon the health of the infected person.

(h) Judging from the result of the examination of convalescent patients at this hospital, paratyphoid fever, of the "B" type, was the commonest disease of the enteric group in France during 1916-17.

(4) *Prophylactic Inoculations with a Mixed Typhoid-paratyphoid Vaccine.*

(a) Paratyphoid bacilli were isolated from the excreta of men who had been inoculated with a mixed typhoid-paratyphoid vaccine.

(b) The proportion of convalescent paratyphoid carriers was less among the inoculated than among the uninoculated: 2.36 per cent and 5.48 per cent respectively.

(c) There were no chronic paratyphoid carriers among the inoculated, among the uninoculated there were 1·89 per cent.

(5) *Carriers of B. aertrycke.*

(a) *B. aertrycke* was isolated from the excreta of three convalescents : 0·3 per cent. In one instance the organism was isolated from the faeces and in two from the urine.

(b) The three patients had come from France.

(c) From each patient the organism was isolated on one occasion only.

(d) Two of the strains isolated were of the "Newport" type; the third strain did not absorb the specific agglutinins from a serum of either the "Mutton" or the "Newport" type.

(6) *Carriers of Anomalous Organisms of the Salmonella Group.*

(a) Such organisms were of frequent occurrence. The two commonest types were non-motile, and produced indol in peptone-water. One of these types produced acid and gas in dulcitate, the other did not.

(b) The frequency with which the different members of this group of organisms occurred in the excreta was subject to very sudden changes; one type of organism might be present in a large proportion of the samples examined during a period of ten days or so, and then disappear altogether; to reappear, perhaps, weeks or months later.

(7) *Carriers of B. typhosus.*

(a) *B. typhosus* was isolated from the excreta of eight patients, i.e., 0·8 per cent. In five cases the organism was isolated from the urine, in two from the faeces, and, in one, from both the urine and the faeces.

(b) Two of these men had come from the East, and six from France.

(c) There were no chronic carriers of *B. typhosus*.

(d) *B. typhosus* was isolated at the first examination in six cases, and, in two, at the third examination.

(e) Six of the eight men had been inoculated with a typhoid vaccine within two years, and two had received a mixed typhoid and paratyphoid vaccine.

(8) *Carriers of B. dysenteriae (Shiga).*

Among 800 men, only one carrier of true *B. dysenteriae* of the Shiga type was isolated; he was a chronic faecal carrier, and had served both in the East and in France.

(9) *Carriers of B. dysenteriae (Mannite-fermenting).*

(a) Dysentery organisms of the mannite-fermenting type were isolated from the faeces of eighteen men, i.e., 2·25 per cent, but in no instance were they found later than the ninth week after the commencement of illness, and in only one case later than the fifth week.

(b) The infection was discovered at the first examination twelve times ; at the second examination four times ; and at the third examination twice.

(c) In only three cases were the organisms isolated on more than a single occasion.

(d) The strains isolated, for the most part, gave atypical serum reactions, but they approximated to the *B. dysenteriae* (Y) of Hiss and Russell.

(e) Infections with organisms of the mannite-fermenting group of dysentery organisms appeared to be common, but of short duration.

(10) *Carriers of Mixed Bacillary Infections.*

(a) Three men were carriers of mixed infections of pathogenic organisms. One was a chronic carrier of paratyphoid of both the "A" and "B" types. The second was a convalescent carrier of *B. dysenteriae* (Y), who became a "precocious carrier" of *B. paratyphosus* B. The third was a chronic carrier of *B. dysenteriae* of the Shiga type, who also became a precocious carrier of *B. paratyphosus* B.

(11) *The Vitality of Paratyphoid Organisms in the Excreta of Carriers.*

(a) Paratyphoid bacilli may remain alive in the solid excreta of a chronic carrier for more than forty days.

(b) If the faeces of such a carrier be mixed with ordinary unsterilized tap-water or with sterile salt-solution, the infecting organisms may remain alive for more than 100 days.

(c) Paratyphoid organisms were not found to exhibit the same vitality in the excreta of convalescent carriers.

(d) The study of the vitality of the infecting organism in carriers may prove to be of value in prognosis.

(12) *The Treatment of Bacillary Carriers.*

(a) Carriers of *B. paratyphosus* A and B, of *B. dysenteriae* (Shiga), and of *B. dysenteriae* (Y), were treated with autogenous vaccines; they were also fed with media containing lactose-fermenting bacilli and cocci, but there was no evidence that the methods adopted exercised any influence upon the infection.

(b) Experiments, made *in vitro*, at room temperature, did not show that Professor Westergaard's streptococcus had an inhibitory action upon the growth of *B. dysenteriae* of the Shiga type, or upon paratyphoid organisms.

A BLOOD CHANGE IN GAS POISONING.

By CAPTAIN JAMES MILLER.

Royal Army Medical Corps (T.).

Pathologist, 2nd Scottish General Hospital.

IN conjunction with my colleague Captain Rainy, I published a note on "A New Sign in Gas Poisoning" (*Lancet*, January 6, 1917) dealing with some fourteen cases of the condition admitted to No. 2 Scottish General Hospital during the month of September last. Since that date, the investigation has been carried out in my laboratory upon cases in Craigmyle and the Auxiliary Hospitals in the Edinburgh area.

I gladly take this opportunity of thanking Major Wallace, C.M.G., Red Cross Commissioner for the district, Dr. Graham Brown and Miss MacNeil, M.B., of Seafeld Military Hospital, Leith, and my colleagues in No. 2 Scottish General Hospital for facilities in the work, and for notes of cases. I would specially mention Captain Glen who has been of great assistance in finding out cases as they came into hospital. For the laborious work of making the blood counts, I have to thank my assistants, Miss Jean McLean, M.D., and Mr. Malcolm Smith. The differential counts have in every instance been made upon at least three hundred leucocytes, and they have been controlled by several observers and by repeated examination.

The further investigation of the matter has merely confirmed the preliminary work as regards the main thesis while modifying the conclusions in one or two respects. Table I gives a general survey of forty-four cases including the original fourteen with differential count, period elapsed since gassing, the immediate symptoms, and the symptoms at the time of examination. The statement in the original note, that this change takes some time to develop, probably three to four months, has to be modified to this extent, that in severe cases the sign appears within a month or six weeks of the gassing, possibly sooner. Cases 33 and 39 show this to be the case. Our original statement was based upon Case 16, which eventually proved to be a much milder case of gassing than the statement of the man led us to believe, the man having since returned to duty.

In order to ascertain whether the relative lymphocytosis was due to an actual increase in the number of lymphocytes or to a diminution in the polymorphonuclear leucocytes, Table II has been drawn up giving a series of cases taken at random in which a leucocyte count was made in addition to the differential count. From the two data—number of leucocytes per cubic centimetre and percentage of the two main types found, the actual number of lymphocytes and polymorphonuclear leucocytes has been given in figures. The first lines of the table give the average in normal cases at what may be taken as the physiological limits and the mean (Gulland and Goodall, "The Blood," 2nd edition, p. 78). This table shows that in all

TABLE I.—GENERAL SURVEY OF THE CASES, EXCLUDING THE FOURTEEN ALREADY RECORDED.

No.	Polymorphs	Lymphocytes	Mononuclears	Eosinophils	Maat	Period between examination	Immediate symptoms	Symptoms at time of examination
15	36.2	55.4	2.3	5.08	0.4	1 month	Twice gassed, unconscious second time	Vomiting, dyspepsia, pains in head
16	75.7	21.7	1.2	1.2	..	2 "	Unconscious	Cough, tightness in chest
17	49.3	45.6	3.0	2.0	..	"	.. .. .	..
18	54.5	36.3	4.0	4.5	0.6	"	.. .. .	..
19	56.2	37.0	1.9	3.9	0.9	1 month	Choking sensation	No symptoms
20	53.8	38.6	4.3	2.1	1.2	6 "	Slight case	"
21	40.3	54.8	1.8	2.4	0.6	13 "	"	Gastric pain, vomiting, losing weight
22	58.5	37.4	2.5	1.1	0.2	12 "	Lost power of legs, but did not go sick	Shortness of breath
23	57.5	35.2	6.7	0.3	..	17 "	Slight case	Chronic otitis media, no present symptoms
24	59.9	37.9	1.1	0.5	0.3	1 "	Could not eat food for several days; stretcher case	No symptoms. Suffering from scabies; discharged fit
25	47.2	48.3	1.6	0.4	0.2	3 "	Became unconscious 4 to 5 hours after attack	Languid, breathless, has sick spells
26	32.1	63.7	2.8	0.9	0.3	3 "	Became unconscious in 1½ hours after attack	Headache, cough, breathlessness
27	50.5	43.2	2.5	3.5	0.5	12 "	Unconscious 4 days	Has frequent attacks like pneumonia which lasts 3 to 4 days and subside
28	52.4	43.7	1.5	1.8	0.3	3 "	Cough and breathlessness	Cough persists, but is much improved
29	70.3	26.9	1.1	1.4	..	3 "	Cough, vomiting, and unconscious ..	Dyspnea and pain in chest
30	53.2	41.9	0.9	3.8	..	2 "	"	"
31	49.4	49.4	0.3	0.3	..	3 "	Slight cough, copious catarrh	Cough and spit
32	56.4	41.7	0.4	1.3	..	3 "	Vomiting, severe headache	Severe headache
33	35.5	56.2	3.0	5.0	0.5	1 "	Vomiting; stretcher case	Dyspnea and pain in chest
34	47.0	49.0	1.08	1.9	0.2	3 "	"	"
35	50.4	44.6	1.7	3.2	..	12 "	No symptoms	"
36	68.0	30.0	2.0	..	..	2 "	Vomited	No symptoms
37	37.8	54.8	2.6	3.5	1.1	12 "	Cough and vomiting	Tight feeling in chest
38	56.3	39.3	1.7	2.7	..	4 "	Not unconscious; vomiting not severe	Wheezing and cough
39	44.0	54.3	0.3	1.3	..	1½ "	Unconscious 4 hours; very severe case	Bronchitis
40	66.7	35.3	2.0	2.0	..	11 "	Unconscious 2 hours; back to duty in 6 days	Breathlessness: tightness in chest; giddiness
41	50.0	45.0	3.0	2.0	..	6 "	Did not feel much at time. A few days after, cough and breathlessness	Complains of shortness of breath
42	59.4	34.9	2.9	1.8	1.0	20 "	In bed with bronchitis for 5 weeks. Indigestion and bronchitis for 6 months thereafter	Bronchitis
43	56.6	35.2	6.7	1.5	..	15 "	Pain, choking sensation, bronchitis lasting 3 weeks	None, but liable to bronchitis
44	47.7	47.5	4.0	0.4	0.4	2 "	Slight	Almost complete loss of sense of smell
								Breathlessness and cough

cases in which the sign is marked, i.e., in the cases in Table II, with the exception of 10, 11 and 16, which were slight, there is an absolute increase in the number of lymphocytes. In certain cases, there is some diminution in the number of polymorphonuclear leucocytes, which tends to accentuate the sign, but the lymphocytosis is nevertheless an absolute one. Moreover, in Cases 13 and 15, which show a fairly well marked leucocytosis, there is still a lymphocytosis. These cases are given in detail below.

TABLE II.

No.		Leucocytes per c.mm.	Percentage		Total	
			P.M.	L.	P.M.	L.
—	Normal { Minimum	5,500			8,850	1,100
—	Normal { Average	7,000	70	20	4,900	1,400
—	Normal { Maximum	9,000			6,300	1,800
1	Severe case	5,000	50	40	3,500	2,930
3	Persistent symptoms	5,968	47	44	2,820	2,676
4	Persistent symptoms	6,570	33	60	2,168	3,942
6	Persistent symptoms	6,500	51	45	3,315	2,925
7	Slight case	7,812	58	35	4,530	2,734
9	Severe case	6,562	39	51	2,593	3,360
10	Very slight case.. .. .	8,124	62	30	5,036	2,437
11	Very slight case.. .. .	7,184	72	23	5,047	1,638
16	Severe case	9,686	75	21	7,264	2,034
12	Severe case	5,000	35	58	1,750	2,900
13	Severe case (first examination) ..	8,122	47	47	3,816	3,816
39	Severe case	11,562	50	46	5,781	5,300
15	Severe case (second examination) ..	17,000	37	58	6,401	10,034
13	Severe case (second examination) ..	15,000	44	46	6,600	6,900

Table III classifies the cases according to the degree of lymphocytosis. It will be seen that all with a count of fifty per cent or more of lymphocytes are severe cases, with the exception of 21, which was a slight case of gassing, but the symptoms have persisted to the present time, i.e., sixteen months after the gassing. Of those with a lymphocyte count of forty per cent or over, all with the exception of two, 31 and 35, are severe cases or cases with persistent symptoms. Too much stress cannot of course be laid on these percentages, but we have found that they are wonderfully constant on repeated examination, and by different observers.

A classification of the cases according to the period which has elapsed since the gassing (Table IV) does not yield any very definite information beyond the fact that the sign is a wonderfully persistent one, and has not disappeared in any instance in my experience.

In this relation, I was fortunate in being able to examine the blood of two schoolmasters (Cases 42 and 43) who had been gassed with chlorine, the one fifteen and the other twenty years previously. Both suffered severely at the time and symptoms persisted, in the one for some weeks, and in the other for many months. The counts in each instance give a slight relative increase of lymphocytes, but they are probably not outside the limits of error.

TABLE III.—CASES WITH HIGH LYMPHOCYTE COUNT.

(A) Count of over 50 per cent.

No.	Lymphocytes	Interval in months	Symptoms
8	56.3	12	Severe case, unconscious four hours
9	51.7	11	Fairly severe, dazed, cough still
12	58.2	17	Severe case, unconscious
21	54.8	13	Slight persistent gastric symptoms
37	54.8	12	Fairly severe, cough and wheezing still
4	60.0	5	Severe case, symptoms still
15	55.4	1	Severe case, persistent symptoms
26	63.7	3	Severe case, unconscious
33	56.2	1	Severe case, vomiting
39	54.8	1½	Severe case, unconscious

(B) Count of over 40 per cent.

3	44.6	12	Marked case, eye symptoms still
6	45.2	12	Fairly severe, eye symptoms still
13	47.6	12	Severe case, unconscious
27	43.2	12	Severe case, still symptoms
35	44.6	12	Slight case, no present symptoms
1	40.8	3	Severe case
2	40.0	3	Marked symptoms
14	40.0	(2)	Partly unconscious, symptoms still
25	48.3	3	Unconscious
28	43.7	3	Slight case
30	41.9	2	Unconscious
31	49.4	3	Slight
32	41.7	3	Vomited, headaches
34	49.0	3	Vomited, stretcher case
41	45.0	6	Fairly severe case, symptoms still
44	47.5	2	Slight case, persistent symptoms

As regards the type of gassing (i.e., whether cloud or shell) it was not always possible to get a decided answer. Of the cases in which a definite statement was obtained, sixteen were cases of cloud gassing, and sixteen cases of shell gassing. As regards the further question of the chemical nature of the gas, nothing decided can be stated. Sometimes the men described the smell and first sensations produced by the gas, but usually, as might be imagined, their minds were not very clear on this point.

The type of gassing and the chemical nature of the gas does not, however, appear to make any difference as regards the blood change. Of the ten cases in which the lymphocyte count is over fifty per cent, four were definitely cases of cloud gas poisoning, and four were cases of shell gassing. In the other two, the nature of the gassing was uncertain.

In eight cases, the statement was volunteered that the gas was of British origin. In twenty-four, it was either certainly or probably German.

On investigating the cases a little more closely, they may be classified into groups. In the first place, a group the counts of which approximate more or less closely to the normal, which are in other words either normal or within the limits of error. Of these six, viz., 5, 10, 11, 19, 22 and 23, are definitely slight cases in which the gassing was a secondary consideration.

TABLE IV.
Nine and over nine months.

No.	Months elapsed	Symptoms	P.M.	Lymph.
3	12	Marked case with eye symptoms	47·6	44·6
5	12	Slight case	58·2	33·4
6	12	Fairly severe with eye symptoms	51·1	45·2
8	12	Severe, unconscious for four hours	37·5	56·3
9	11	Fairly severe, dazed, cough still	39·9	51·7
10	12	Slight case, no present symptoms	62·3	30·2
11	9	Slight case, no present symptoms	72·1	23·4
12	17	Severe case, unconscious	35·3	58·2
13	12	Severe case, unconscious, but no symptoms now	47·9	47·6
21	13	Slight case	40·3	54·8
22	12	Did not go sick, still breathless	58·5	37·4
23	17	Slight case, no present symptoms	57·5	35·2
27	12	Severe case, still complains	50·5	43·2
35	12	Slight case, no present symptoms	50·4	44·6
37	12	Fairly severe, cough and wheezing still	37·8	54·8
40	11	Fairly severe, symptoms still present	66·7	35·3
<i>Six or under six months.</i>				
1	3	Nausea, severe gassing	50·2	40·8
2	3	Marked symptoms, symptoms still	53·1	40·0
4	5	Severe, symptoms still	33·5	60·0
7	2	Very slight case	58·5	35·0
14	2	Half unconscious, slight symptoms still	50·0	40·0
15	1	Twice gassed, unconscious, symptoms still	36·2	55·4
16	2	Unconscious	75·7	21·7
19	1	Choking sensation	56·2	37·0
20	6	Slight case	53·8	38·6
24	1	Stretcher case	59·9	37·9
25	3	Unconscious	47·2	48·3
26	3	Unconscious	32·1	63·7
28	3	Slight cough, breathlessness	52·4	43·7
29	3	Unconscious	70·3	26·9
30	2	Unconscious	53·2	41·9
31	3	Slight case	49·4	49·4
32	3	Vomiting and headache	56·4	41·7
33	1	Vomiting, stretcher case	35·5	56·2
34	3	Vomited, stretcher case	47·0	49·0
36	2	Slight case	68·0	30·0
38	4	Vomiting, persistent bronchitis	56·3	39·3
39	1½	Severe case	44·0	54·3
41	6	Fairly severe, persistent bronchitis	50·0	45·0
44	2	Slight case, persistent bronchitis	47·7	47·5

Taking 22 as an example :—

22. This is the case of a man who was gassed on September 25, 1915, through lifting his helmet for a couple of seconds only. He lost the power of his legs for some ten minutes, but did not vomit. He has always suffered from bronchitis and asthma, but has been worse since the gassing. He did not go sick until some time afterwards, but he has since been dismissed from the Army on account of his asthma. This is a case in which a condition previously present was aggravated by gassing, but clearly the actual gassing was not severe.

There is another series of cases in which counts approximately normal were obtained, but in which the gassing was moderately severe. These require a rather more careful scrutiny. Such are 16, 24, 29, 36, 38 and 40.

16 is a man who was gassed in July, 1916. His statement is that he was rendered unconscious, and he complained when admitted to hospital of cough and tightness in the chest. He was sent to a convalescent home soon after where he was punished for breaking bounds, and he has since rejoined his unit and has received promotion. It is clear that he cannot have been a severe case of gas poisoning.

24 is a man who was gassed with cloud gas in August, 1916, through not having his helmet on. He was not rendered unconscious, but had to be carried back on a stretcher. He could not eat food for several days. He suffered from cough. His symptoms had practically disappeared before admission to hospital. A note from the medical officer of the convalescent home to which he was sent states that he had neither gastric nor pulmonary symptoms when discharged. He has since rejoined his unit.

29 is a man who was gassed with shell gas at the end of July, 1916. He had no helmet on and suffered from vomiting and breathlessness at once. These symptoms continued. Fourteen hours later he became unconscious and remained so all day. He continued to suffer from cough with expectoration, and when admitted to hospital complained of breathlessness on exertion and pain in the chest. No heart lesion was found on auscultation. Although showing an almost normal blood count October 25, 1916, a month later the count was as follows: Polymorphs 58·7, lymphocytes 39·3. The man was suffering from psoriasis. This man volunteered the statement that the gas smelt like ammonia.

38 was gassed at the same time as 29. He states that the gas, which was shell, had a sickly sweet odour. He vomited immediately, but had no cough or breathlessness, and did not become unconscious. He was able to put on his helmet. He continued in action all night and felt better in the morning. His age is 41, and he has suffered from cough for many years. His present attack of bronchitis began two months after the gassing. He is evidently a case of chronic bronchitis of long duration.

40 was gassed in December, 1915. He is uncertain whether it was shell or cloud gas, but it had a "pleasant smell." It made his eyes water and caused severe coughing. He felt "intoxicated" and became unconscious, remaining in this condition for about two hours. He vomited freely in the dressing-station. He returned to duty after six days. He has always been subject to asthma and bronchitis, but since being gassed he has been very short-winded. His medical officer has no doubt that he exaggerated the story of the gassing, as he makes the most of all his ailments. His present attack of bronchitis does not appear to have been connected with the gassing. A second examination of his blood, a month after the first, resulted as follows: Polymorphs 57·5, lymphocytes 33·5.

36 is a man gassed with shell gas, August 21, 1916. He vomited but did not become unconscious. He complains of having a large amount of spit every morning. He complains of a tight feeling in the chest and

a pain in the left side. He looks very well, and nothing can be made out on examination. The film, which was sent from a distance, was bad. No great reliance can, therefore, be placed on the result, but as the man has returned to duty the case is obviously a slight one. The Medical Officer of the Convalescent Home regarded the man as making the most of his condition.

It will be seen that of the above-mentioned cases, three are much less marked cases of gas poisoning than the story of the patient would indicate, all having returned to duty within three months of the gassing. Other two are cases of chronic bronchitis which happened to be gassed, but a considerable interval elapsed between the gassing and "going sick." 29, the only remaining one of the series, is apparently a clear case of pretty severe gas poisoning without marked blood change. A complication in this case, however, is a skin condition—psoriasis.

The remaining cases may be classified into groups according to the nature of the chief symptoms. The larger proportion show at some period more or less marked symptoms associated with the respiratory passages. In another series of cases the symptoms are mainly gastric. Not infrequently both types are to be met with together. Still another series is those in which nervous symptoms predominate.

In a small group of two cases, 3 and 6, gassed at the same time (September, 1915, British gas) the chief symptom was obstinate conjunctivitis. This was associated with tremors. It is possible that the nature of the gas has something to do with the peculiarity of the symptoms. It is a striking evidence of the profound effect which gassing has upon the tissues of the body that a year after the gassing the conjunctiva should exhibit such marked inflammatory change.

Nervous phenomena are exhibited by a large number of cases sometimes in the form of what may be called neurasthenia, as in Cases 15 and 27. Headache is severe and persistent in some, e.g., 16 and 32.

Tremors were present in Cases 3, 4, and 6.

Gastric symptoms are among the most obstinate in some cases. Two of these, 13 and 15, are worth recording, as they are associated with a high leucocyte count.

13 was gassed (British) in September, 1915. He lost consciousness some hours afterwards, and remained unconscious for four days. For several days afterwards he suffered from intense nausea and vomiting, and these persist in some degree up to the present time. He was sent home, and after a month returned to the Front, and remained there from November, 1915, till July, 1916.

He remained fairly well until May, when he began to suffer from pains, particularly in the shoulder and chest, like a knife going through him. He was again sent home, and has been twice in Craigleith Hospital, with intervals at convalescent homes. He has constant nausea and disinclination for food, and occasionally vomits. The pains in the chest

and limbs also persist to the present time. His blood shows a persistent moderate leucocytosis (15,000). His differential count on last examination was polymorphs 44, lymphocytes 46. There is thus an absolute increase in the polymorphs as well as in the lymphocytes, although it is more marked in the case of the lymphocytes (see Table II).

15 is a very similar case who was gassed on two separate occasions: once, July 30, 1916, slightly, owing to sleeping through a gas attack in his dug-out. On another occasion, August 3, 1916, while trying to extricate an officer from his dug-out after the explosion of a shell. On the latter occasion he was rendered unconscious. His case is complicated by neurasthenia following shell shock. He suffers from persistent pains in the head and dyspepsia, with frequent vomiting. His blood shows a moderate leucocytosis, 17,000. His differential count on the first occasion was polymorphs 36.2, lymphocytes 55.4 on the second occasion, three months later 37.3 and 58.3 respectively. The man is still in hospital and shows little sign of improvement. The question arises as to what the leucocytosis is due to in these cases. Gastritis is undoubtedly the most promising symptom, and it is reasonable to suppose that subacute inflammation of the gastric mucous membrane might account for it. The interesting point is that the lymphocytes are more markedly stimulated than the polymorphs.

The cases with marked and persistent respiratory symptoms are most numerous. The common complaints are pain in the chest, cough and breathlessness. Such cases are 9, 25, 26, 31, 33, 37, 39, 41.

9 was gassed (British) October, 1915. He was exposed for twenty minutes, but only complained of feeling dazed. He suffered from cough for three months, and in September, 1916, complained chiefly of breathlessness. On auscultation crepitations could be heard in both lungs. His was the case which first drew attention to the blood alteration. His count, confirmed on several occasions, was thirty-nine per cent polymorphs, fifty-one per cent lymphocytes. His leucocyte count was 6,562 per cubic millimetre.

31 was gassed July 25, 1916 (shell). He was partly buried by the explosion and stunned. He had breathlessness from the first, also vomiting. He was conscious at the time of a sweet, rather pleasant, odour. At the time of examination, October 20, 1916, he had a slight cough and somewhat copious catarrhal expectoration. He has a scorbutic skin condition. The percentage of polymorphs and lymphocytes was the same, viz., 49.4.

37 was gassed September 25, 1915 (British, burst cylinder). He was rendered unconscious by the shell which burst the cylinder, so that he had a good dose of the gas. When he recovered consciousness, he started coughing and vomiting. He complains October 10, 1916, of pain in the right side of the chest. He is troubled with wheezing and coughing. His medical man not being able to make out much in the way of physical signs

regards the man as a humbug. His count is polymorphs 37·8 per cent, lymphocytes 54·8 per cent.

39 was gassed October 15, 1916 (shell). He noticed a sweetish odour which caught his breath. He was unconscious for four hours. Oxygen was administered for four days. His most prominent symptoms are breathlessness, pain and tightness in the chest and giddiness. He complains also of impaired digestion. His count was polymorphs 44 per cent, lymphocytes 54·3 per cent. His leucocytes numbered 11·562.

41 was gassed May, 1916 (shell). He did not feel much at the time.

A few days afterwards he developed cough and breathlessness. He is still suffering from bronchitis. His count is polymorphs 50 per cent, lymphocytes 45 per cent.

The type of leucocyte which is increased is the small lymphocyte with relatively large deeply staining nucleus and relatively little protoplasm. In a few cases there was a fair sprinkling of larger lymphocytes with a broader rim of protoplasm and a larger nucleus. No other type of blood cell appeared to be influenced in any constant fashion.

The last point which arises is the question of the cause of the blood change. A relative or absolute lymphocytosis is met with as an accompaniment of a large number of pathological conditions. Of the list mentioned in Gulland and Goodall only one, viz., chronic catarrh of the small intestine (relative lymphocytosis)—seems to have any relation to conditions met with in gas poisoning. Undoubtedly, gastric catarrh is a prominent symptom in a large proportion of these cases.

The blood change would appear to have no relation to the nature of the gas employed. Apparently therefore, it is due to some change set up which is common to all types of gas poisoning. It may be that it is the chronic catarrh of respiratory or alimentary mucous membranes which explains it, but we are still in the early stages of our knowledge of the effects of gas poisoning on the body. They are undoubtedly very profound and persistent. No mention is made of any blood change in the "Official Memorandum on Gas Poisoning in Warfare," but that pamphlet deals only with the immediate effects of the various gases. We know, however, that catarrh of respiratory and gastric mucous membranes is present in the early stages, and tends to persist. Lymphocytosis is met with in tuberculosis, syphilis and other subacute and chronic infections. From analogy, therefore, one would judge that the chronic catarrh is a factor in the production of the change. In two cases with marked gastric symptoms, there was a moderate leucocytosis with a persistent high lymphocyte count.

Recently, I had the opportunity of examining the blood of an officer who was accidentally gassed in this country with chlorine. The accident happened January 24, 1917, and the blood was examined January 27, 1917. The red cells numbered five and a half million, the hæmoglobin was 98 per cent, and the white cells were 5,900 per cubic millimetre. Beyond a slight leucopenia, there was therefore no change. The differential count was normal, polymorphs 68·5 and lymphocytes 25·5.

Little can be gathered from the examination of a single case, but what evidence there is goes to show that the gassing results in a destruction of leucocytes, but that at such an early stage there is no stimulation of any one type of leucocyte. The case was a very slight one, the patient returning to duty within a week of the gassing.

SUMMARY AND CONCLUSIONS.

(1) In cases of gas poisoning in which symptoms persist, there is an increase in the number of lymphocytes relative and absolute in the circulating blood. In slight cases this may not be beyond the normal limits or in excess of what may be met with from other causes. In any marked case, however, the change is sufficiently striking to be of some importance in cases where the medical officer is in doubt as to the reliance to be placed upon the statements of men complaining of having been gassed.

(2) The blood change is elicited by a differential count of the leucocytes, and it may be taken that a count in which the percentage of lymphocytes approaches that of the polymorphonuclear leucocytes, indicates that the patient is still suffering from the effects of the gassing, i.e., provided there is no other complicating disease present which might produce a similar change. A slight relative lymphocytosis is not an uncommon finding in men from overseas, or in anyone, so that no great reliance can be placed upon the sign unless it is marked, i.e., unless the percentage of lymphocytes approaches closely that of the polymorphonuclear cells.

(3) The cell which is increased is the ordinary small lymphocyte of the blood. There may be, in some cases, a diminution in the number of polymorphonuclear leucocytes which will of course accentuate the sign, but the increase of lymphocytes is an absolute one. Moreover it appears in cases with a high leucocyte count.

(4) The change is one which develops early, probably within a month of the gassing, and continues for a long time; in cases with persistent symptoms for at least eighteen months.

(5) The change appears to be independent of the kind of gas, and it is shown by patients exhibiting many varieties of symptoms.

(6) It is not clear what the change is due to, but from analogy with other conditions exhibiting a lymphocytosis, it is probable that chronic inflammatory change in respiratory and gastric mucous membranes is at least a factor.

We venture to draw attention to a point which appears to be of some interest and, possibly, of importance which has recently come under our notice as the result of differential blood counts in cases of gas poisoning. We have not yet examined any very large number of cases, but we are extending our observations and hope to publish them in detail at an early date. We have made inquiries and have looked up some of the literature, e.g., the "Memorandum on Gas Poisoning in Warfare with notes on its Pathology and Treatment," and have failed to find any similar observation.

Name	Polymorphs	Mononuclears	Lymphocytes	Eosinophiles	Mast cells	Leucocyte count	Remarks
Sapper J. McD.	50.2 per cent	4.6 per cent	40.8 per cent	3.4 per cent	0.8 per cent	5 700	Gassed June, 1916 : helmet was blown off, and he lay in a wounded condition exposed to a gas shell attack; nausea the only after symptom.
Pte. T. S. ..	53.19 "	5.5 "	40.0 "	0.4 "	0.8 "	--	Gassed September, 1915 : marked symptoms : discharged from Army as a result (September 1916).
Pte. J. McL.	47.6 "	2.6 "	44.6 "	1.8 "	1.8 "	5,968	Gassed September, 1915 : marked eye symptoms and tremors still present.
Pte. A. Y. ..	33.5 "	3.7 "	60.0 "	1.0 "	0.7 "	6,570	Gassed April, 1916, fairly severe, cannot march any distance; tremors.
Cpl. R. S. ..	58.2 "	2.8 "	38.4 "	4.6 "	0.9 "	--	Gassed September 25, 1915, very slight, did not report sick, no symptoms now.
Pte. J. D. ..	51.2 "	1.4 "	45.2 "	2.2 "	--	6,570	Gassed September, 1915, suffers still from eye symptoms and tremors.
Lieut. J. McG.	58.5 "	3.8 "	35.04 "	2.5 "	--	7,812	Gassed July, 1916, exposed for a short time; no symptoms.
Pte. H. H. ..	37.5 "	3.2 "	56.3 "	2.6 "	--	--	Gassed September, 1915, buried near a burst cylinder; unconscious for four hours.
Lieut. A. D...	39.9 "	4.3 "	51.7 "	3.2 "	0.8 per cent	6,562	Gassed October, 1915, exposed for twenty minutes; dazed; cough for three months.
Pte. G. R. ..	62.3 "	4.3 "	30.2 "	1.2 "	1.9 "	8,124	Gassed September, 1915, very slight, no after effects.
Gnr. J. N. ..	72.1 "	2.5 "	23.4 "	2.0 "	--	7,184	Gassed December, 1915, very slight, no after effects.
Pte. W. F. ..	75.7 "	1.2 "	21.7 "	1.2 "	--	9,686	Gassed July, 1916, rendered unconscious; suffers from cough, tightness in chest.
Cpl. A. H. ..	35.3 "	2.7 "	58.2 "	3.2 "	0.2 per cent	5,000	Gassed April, 1915, in hospital at the time; hospital blown up; unconscious for a few hours; cough, shortness of breath, and nausea.
Pte. E. B. ..	47.9 "	2.4 "	47.6 "	0.3 "	1.5 "	8,122	Gassed September, 1915, unconscious for four days. Intense nausea and vomiting for several days. No cough.

Note.—The results represent an analysis of 300 to 500 leucocytes and in several instances the counts were repeated on more than one occasion and by more than one observer.

We append a table of a series of fourteen cases taken at random, an analysis of which appears to bring out the following facts:—

(1) A case which has been gassed sufficiently severely to produce symptoms lasting for some time shows a more or less marked relative lymphocytosis.

(2) This change in the blood takes some time to develop. Probably three to four months at least must elapse before the change appears, but once it develops it does not disappear for some time, apparently for at least a year, if symptoms of any kind persist. -

We are not able to state whether this sign is present in all types of gas poisoning or only in certain of them, because it is a difficult matter to obtain any definite information on this point from the patient himself.

As regards the number of the leucocytes per cubic millimetre, there does not appear to be any marked change; if anything, there is a slight reduction.

THE PSYCHOLOGICAL ASPECT OF AN ARMY AND AN UNORGANIZED CROWD.

By MAJOR R. EAGER.

Royal Army Medical Corps.

Deputy Medical Superintendent, Devon County Asylum; Medical Officer in Charge Mental Division, The Lord Derby War Hospital, Warrington.

THIS article lays no claim to anything original. It is merely a résumé of other works on the subject to which I refer the reader in the books mentioned at the end of the text. All that has been attempted has been to review the psychology of the subject of organized and unorganized crowds and place it before those who, at the present juncture, may be interested enough to peruse it.

We may define mind as an organized system of mental forces and every highly organized collection of men may be said to possess what is called a "collective mind." In this way psychology extends from the individual to the group and this is the branch of psychology about to be discussed. In every society of men each new member becomes moulded into the ways of thinking, feeling, and acting of the group, but a vast amount of training and discipline is necessary in many cases to render him able to take his proper part in the group. Human minds resemble one another just as their bodies do, and there is a certain standard or type to which individuals amongst a group more or less closely conform, and mental differences, just as physical differences, arrange themselves about this standard or type. We must recognize that each individual behaves in this or that way because the impulses with which he is endowed are set towards this or that end, and that each individual's conduct is affected through the "mass" by three very important influences, i.e., "suggestion," "sympathy," and "imitation." We will consider these *seriatim*.

(1) *Suggestion*.—We all tend to accept without question the beliefs we find established in the minds of our fellows by "suggestion." If a proposition is made to us by a number of different persons it is difficult for us to retain a critical attitude, and we accept it unreservedly. Still more is this the case when a proposition comes as a "mass suggestion" from the whole group at the same time. Even when we reason with strict logic we commonly do so from premises which are beliefs acquired in this unreasoning fashion. We see, therefore, that "mass suggestion" plays a very important rôle in any large body of persons.

(2) *Sympathy*.—The tendency to experience in the face of the same object the same emotion and impulses that are revealed by the behaviour of our fellows is due to the effects of sympathy. It is sometimes spoken of as "sympathetic contagion." As an example I will quote the story of an officer's experiences in the trenches as he told it to me when passing

through a dressing station at which I was on duty. An exploding shell buried this officer and a colleague standing close to him. Out of the debris thrown around them they were just able to look towards each other and this officer saw his colleague apparently laughing at him. On reflecting, he considered the circumstances far from ludicrous, but out of "sympathy" for his companion brought himself to laugh back at him. In return his colleague made some wild grimaces and began shrieking and went raving mad. The officer whose personal statements I have quoted was passed down to the base suffering from mental symptoms following on "shock."

All our emotions are capable of spread by sympathy. As a typical illustration of this I remind you of "Mafeking Night," during the South African War, when all England expressed itself in an outbreak of "national hysteria." Each member of the crowd on that occasion by sympathy not only responded to the first news of the "relief" of the besieged town by a shout of joy but saw joy expressed in every face and every gesture, and gave themselves over to an outburst of enthusiasm the like of which has never been known of before. "It was not courage that made me fearless of death" said the officer after his first bayonet charge; "it was just the thought of all the heroes who have been soldiers of my regiment." This officer was surely under the influence of "sympathetic contagion."

(3) *Imitation*.—The tendency to direct in detail our impulses according to the pattern of our fellows is the effect of "imitation." If we depart from the custom of our particular set in matters of dress or amusement an uncomfortable feeling comes over us. This develops into a feeling of isolation, which may be illustrated in the man who sees large numbers of his friends joining the ranks of Kitchener's Army, and stands aloof himself. These feelings are due to inherent impulses in us to behave in the same way as our fellows and not to be isolated from them, and are akin to the "herd instinct" of animals. They teach us to restrain our own personal instincts of self-preservation in order to protect others and benefit the "mass" and they play a most important part in the building up of our morals. Like all other psychological processes, however, they are subject to perversion, and examples of this are not far to find. We have had occasion to observe on many occasions during the present War instances of officers, and among them, I regret to say, medical men belonging to the best families in Germany, who have taken active parts in pillage. They have not refrained from plundering works of art, money, or even women's clothing and numbers of things, for the taking of which there could be no excuse. Whether any uncomfortable feelings arose in these officers' minds is not known, but there is no doubt about the fact that many of their subordinates followed their actions by "imitation" just as in our own country has been the case with the "conscientious objectors."

This leads us to the consideration of the psychology of the unorganized crowd. There are two forms of crowds, one the organized, and the other a collection of separate individuals ready to perform dissociated, uncertain and disconnected actions.

So long as a crowd possesses no organization there will be a spirit of indifference amongst its members. The individuals will degenerate, and panics, fads, and false beliefs will result which may be looked upon as derangements of the "collective mind" of which panic is probably the crudest example. An example of this is the panic which so often follows the shout of "fire" in a crowded theatre. The suggestibility and emotional excitability of an unorganized crowd is very great, its sense of responsibility is diminished and there is a feeling of loss of identity amongst its individual members. Each individual of an unorganized crowd feels himself to be an indistinguishable unit of mass and that judgment will be placed on the mass rather than on himself. The agitation for the release of driver Caudle of the Aisgill railway disaster in 1913 showed that the sense of unity amongst railway servants has produced among the individuals a lessened sense of responsibility towards the community at large. Syndicalism leads to a state of loss of moral balance in the industrial group and influences for evil the individual members by producing recklessness, inefficiency and indifference to the common welfare.

It is only by sharing in the "collective life" of highly organized masses of people that the individuals are raised above the level of selfish behaviour, and this brings us to the subject of—

Army Organization.—We must not conclude that by sharing in "collective life" by being a member of "a group" necessarily means to suffer degradation. In the case of a regiment the individuals live in a society where their conduct affects and is affected by the conduct of others by "suggestion," "sympathy," and "imitation," but there is in this case an organization at work by which loss of personal identity and responsibility is prevented, and as a result we find that in an organization such as the British Army the attainments of the mass are on a higher level than could possibly be reached by its average members.

A well organized and patriotic army is the product of deliberate design. The intelligence of a highly selected staff, deliberating and deciding, with the aid of a vast amount of information supplied by subordinates, who in their turn have been specially selected, directs its movements. Influence and responsibility rest on those members best qualified for such posts, the men with the firmest courage and finest enthusiasm occupy the positions of greatest prestige, and by their conduct inspire those who stand next to them, and by "imitation" this is transmitted downwards throughout the entire system. The whole object "collectively" is directed to a single end, the defeat of the enemy, which is perfectly clearly defined and willed by each individual in the army.

In such a high standard of organization there exists also what is known as a "group spirit." This implies the existence in each soldier's mind of a sentiment of devotion to the Army to which he belongs. In a well organized army the "group spirit" is not single but multiple. Each man not only possesses the sentiment of devotion to the Army as a whole, but also

has a similar feeling for the corps, regiment or company to which he belongs.

It was the boast of Napoleon about his army that it was more noted than any other army in the world for the extraordinary feats of heroism displayed by its individual members.

The moral side of each individual of such a collective group is raised to a high level by virtue of its organization. Each man is sustained through months of fatigue, suffering and discomfort by the presence of this "sentiment of devotion," and a part of decisive importance is played by its presence at each critical period of battle.

We see, therefore, that mass suggestion, sympathetic contagion and imitation are not suspended in organized crowds, but that their operation is modified and turned wholly to good.

As I stated at the beginning of this paper, every highly organized body of men may be said to possess a "collective mind." This "collective mind" though undoubtedly a source of strength is not without its dangers, for if it puts at the disposal of the "directors" a body organized and united as one man, it at the same time renders the body highly susceptible to waves of emotion, which, if not properly checked, may overwhelm reason and lead to the disgrace of that body of men. We have an example of this in the extraordinary rapid spread of the German nation's hatred against England, and the fearful barbarities that have been introduced into this War by them in consequence.

Under the shock of war we, in England, united as we have never done before. People were taken out of themselves and thought of others, sympathized with others, and for the first time in their lives worked for others. All classes were brought closer together and a "collective mind" was borne upon us which has probably done our country an immense amount of good.

There need be no apprehension of any serious disturbance by emotional epidemics when a "collective mind" has been formed amongst a free people who have been accustomed to the unfettered exercise of their own judgment. We can, therefore, rest assured that our emotions will not play us false as has been the case with our enemies, who instil into their battalions the dominant thought of cohesion by orders from without and not from among the troops themselves. Whereas it has been our boast, and that of the French, that when our men are face to face with a great difficulty their resourceful intelligence sees what should be done, and there is thus created at the time amongst themselves the essential "collective mind."

BIBLIOGRAPHY.

- "The Psychology of Insanity." BERNARD HART.
- "Physiological Psychology." W. McDUGALL.
- "Principles of Psychology." Prof. JAMES.
- Papers on "Herd Instinct." *The Sociological Review*, 1908-9.
- "Manual of Psychology." Prof. STREET.
- "The Narrative of a Professor of Louvain." *The Hibberd Journal*, January, 1915.

Clinical and other Notes.

A PRELIMINARY CONTRIBUTION ON "P.U.O. (TRENCH FEVER)."

BY CAPTAIN F. C. DAVIES.

Royal Army Medical Corps.

AND

CAPTAIN R. P. WELDON.

Royal Army Medical Corps.

ALMOST the only real contribution to our knowledge of this disease, somewhat unfortunately termed trench fever, which has been published, is contained in the report of the very careful and valuable work carried out under the guidance of Colonel Sir Wilmot Herringham, R.A.M.C., by Captains McNee, Arundel, Renshaw and Brunt, R.A.M.C. Stated briefly, they have told us that the disease is almost certainly due to an organism which is probably contained in the red corpuscles of the infected persons and that the corpuscular elements of the blood alone are capable of containing and transmitting the disease.

This valuable discovery is quite in accordance with what one would expect, judging by the clinical characters so markedly shown in typical cases, and which in certain respects are not unlike attacks of malaria. In the main, one would outline these as follows: Sudden onset, occasionally with chill. Onset, with indefinite but well marked weakness and malaise, frequently indescribable so far as the patient is concerned, who when pressed to an extremity in so many instances says "Well, my legs would not hold me." Pyrexia, severe or slight, irregular, tending to intermit and with a well-marked suggestion of periodicity of from two or three, to five days. Pains, characteristically lumbar, head or legs, all or any, at onset. "Shins" later and with extraordinary consistency; vomiting may occur. In character the pains are best exemplified in these so-called "shin pains," and are of a severe boring character and neuralgic in type, being very frequently associated with marked tenderness of the nerves of the calf, including the external popliteal where it passes round the neck of the fibula, where it is frequently exquisitely tender to pressure. The pains are not necessarily confined to the shins, but may extend above the knees as far as the thighs, *missing the joints*.

Certain negative signs and symptoms of great value when differentiating from the minor maladies are: freedom from catarrhal conditions of the upper and lower respiratory tracts, absence of dryness or furring of the tongue even with a temperature of 102° or 103° F. The pulse is remarkably stable, and the general feeling of the patient whilst in bed is summed up best in the words they frequently use: "If it were not for this headache I should be all right," or "If it were not for these pains in my back I should be all right." A mental attitude which is, in the opinion of the authors, unheard of in the typhoid and paratyphoid infections. The spleen is not usually appreciably enlarged either to palpation or percussion. Bowel symptoms we believe not to be characteristic of

the condition, though frequently amongst troops, as one would expect, one sees it associated with slight attacks of diarrhoea.

On the course of the disease we cannot speak with confidence, but it would appear that in the majority of cases at least three exacerbations of fever take place extending over an interval of *not less than two weeks*. The pains are, unquestionably, frequently severe and persistent, though not disabling. The blood shows an absence of any ascertainable growth on ordinary media. A count showing moderate leucocytosis only, with some increase of the large lymphocytes, and an absence of eosinophilia, and no recognizable hæmatozoa. One feels it necessary in describing what, to most of us, is a new disease, to emphasize the importance of taking into consideration all the aspects of the case, and not to rely upon the presentation of a typical temperature chart or the presence of typical "shin pains" or any other single characteristic, a mistake which is frequently made. With this reminder we are convinced that we have in this condition a disease of undoubted individuality quite distinct from, and in the vast majority of cases easily differentiated from influenza, common cold, bilious attack and myalgia, on the one hand, and the enteric group, malaria and rheumatic fever on the other, and, in its typical instances, as easily diagnosed as any better-known disease, and in its atypical cases well recognized by those who have studied such numbers of cases as the medical division of any large base hospital must provide.

With regard to treatment, it would not appear that any remedies yet tried have materially modified the course of the disease, and this fact combined with the leakage of men which the wide prevalence of the disease appeared to us to cause, led us to a belief in the extreme importance of prophylaxis.

Our attention was thus drawn to the mode of transmission, and with the data provided by the workers already mentioned in our possession, and also the clinical fact that direct transmission in hospital appeared not to exist, it seemed to us that the direct transmission of red corpuscles must be brought about by blood-sucking parasites. The wide prevalence of the "louse," as has been so thoroughly investigated by Lance-serjeant A. D. Peacock, R.A.M.C., led us to the belief that these pests were the guilty agents.

An experiment was, therefore, carried out with a view of testing the accuracy of this belief. Some score of lice were collected and starved in captivity for three days; a number of them died. Two pairs of the survivors were taken and allowed to bite, under a watch-glass, two patients suffering from "trench fever" in an acute stage. After allowing them to feed for about fifteen minutes their meal was interrupted, and each of us then allowed a pair to feed upon himself, strictly confining their sphere of operations by means of a securely-fixed watch-glass. The one of us whose duties did not bring him into the wards, subsequently, twenty-four hours later, allowed his pair to have a further meal on himself. Twelve days later very startling developments took place. The characteristic symptoms manifested themselves, and he passed through a most typical attack of the condition, of average severity, with the pains and other features all present.

It may be further noted that the victim had not at any time been nearer to the front than the base, nor had he been subject to any previous similar condition.

The demonstration of this mode of transmission appears to be so striking in its success, and of such immediate importance, and the probability of a vigorous impulse to the anti louse campaign being given by its recognition, amply justifies us in giving what is an academically incomplete research on the etiology of this important disease.

OBSERVATIONS ON A SEVERE CASE OF TETANUS TREATED WITH
REPEATED INTRATHÉCAL INJECTIONS OF ANTITOXIN.—
RECOVERY.

BY CAPTAIN C. C. WORSTER-DROUGHT.

Royal Army Medical Corps.

As the problem of a moderately successful method of treatment in cases of severe tetanus still awaits a definite solution, the record of the following case with observations thereon may be of some interest at the present time. As far as I am aware, the gross amount of antitoxic serum administered was considerably in excess of that mentioned in hitherto published records; this fact may serve as an additional excuse for the publication of this case.

Private M., aged 24, while in the trenches, was wounded by shrapnel in the left ankle on the morning of July 1, 1916. He lay where he was hit for about half an hour before being removed to the dressing-station, but a field-dressing was put on within a few minutes of the infliction of the wound. He was then transferred to the base and finally arrived at hospital in England on July 4. From July 1 to 4, the wound was dressed twice daily.

I am indebted to Captain Craster for the notes of his progress from arrival until July 8. On admission there was a penetrating circular wound at the junction of the lower and middle thirds of the left ankle. The entry, 2½ inches in diameter, was at the external border of the tibia; the exit, of about the same size and at the same level, being just over the fibula. The wound was very septic with considerable swelling and œdema of the surrounding tissues; it was irrigated and a eusol dressing applied. Radiographic examination showed the bones to be quite intact. A label attached to the patient stated that a prophylactic dose of antitoxin (500 units) had been given on July 1. Two days after admission (July 6), the wound was explored, irrigated, and drained under general anæsthesia. No metal fragments were found, but some pieces of cloth (puttee) were removed. Next day the wound was looking better, draining well, and the surrounding parts were not so inflamed. During the evening of the day following (July 8), at about 10 p.m., the patient complained of some slight stiffness in the neck; there were no other symptoms and he slept well that night.

On the following morning (July 9), when visited, he showed well-marked rigidity of both the anterior and posterior muscles of the neck, some degree of trismus, and complained of cramp-like pains in the back. The expression was anxious, swallowing was a little difficult, and on observation he was seen to be having slight spasms of the head, retraction about every ten to fifteen minutes. The pupils were normal and there was no nystagmus; the knee and ankle jerks were equal and not exaggerated. The right plantar reflex was flexor, and that

on the left (the wounded limb) was not obtained. There was some tonic spasm of the abdominal muscles; the abdominal and epigastric reflexes were not elicited but the cremasterics were slight on each side.

As the patient had already received a prophylactic dose on July 1, according to his label and own statement, anti-anaphylaxis was first induced before proceeding with treatment. This was done by the method mentioned by C. H. Browning [1], and based on the work of Besredka and Friedberger—viz., five cubic centimetres of antitoxin serum were diluted with fifty cubic centimetres of normal saline. Of this mixture 1 cubic centimetre was injected intravenously. After four minutes this was followed by a further 3 cubic centimetres, two minutes later 10 cubic centimetres were given, and finally after another two minutes 25 cubic centimetres. The serum was run in by the ordinary method, the rubber tube of the apparatus being clipped during the intervals. Half an hour later the patient was given the following amounts of antitoxin in the situation indicated:—

Intrathecally	..	..	..	..	8,000 units (U.S.A.)
Intravenously	..	..	..	..	12,000 "
Intramuscularly (in the wounded limb)	..	..	..	..	4,000 "

The intravenous injection was given not with the idea of influencing the toxin already in the nervous tissues, which, as Noon, Park, Nicole and others have shown, is dealt with by the intrathrecal antitoxin, but rather to neutralize any in the general circulation.

In the evening he complained of excessive tightness across the chest; severe spasms occurred about every quarter hour and continued throughout the night, consequently sleep was very limited. Next day (second) there was little change with the exception that the spasms seemed rather more severe. He was able to swallow small quantities of milk, but the attempt, more frequently than not, provoked a spasmodic seizure. 10,000 units of antitoxin were given intravenously to neutralize any remaining toxin, and 8,000 intrathecally. During the night he was somewhat better, took twenty-four ounces of milk and slept four to five hours. On the third day there was extreme retraction of the head and moderate opisthotonus; the slightest attempt at swallowing brought on a convulsive spasm. 8,000 units were again given intraspinally and this dose was continued daily until the twelfth day. From the third to the sixth day, opisthotonus became increasingly pronounced, risus sardonicus was well marked, he was quite unable to swallow and seizures were frequent. During this period he was given nutrient enemata. On the morning of the sixth day he was able to open his mouth to a small extent and could swallow a little, though there was some choking after each drink; he was less restless during the night and the spasms were of shorter duration, their frequency being undiminished. Head retraction was not so extreme. On the seventh day the seizures were certainly less severe and the intervals between them longer; they were, however, precipitated by any attempt to speak. The patient indicated his chest and tongue as the site of pain; his tongue had evidently been bitten, in spite of precautions, during the previous convulsive spasms. He slept at intervals most of the afternoon, and on awakening was able to swallow better. From this time until the tenth day the patient's condition remained much the same; spasms occurred from time to time, usually being more frequent in the morning and late in the evening. Head retraction and trismus persisted to a marked degree with a tendency to opisthotonus; he was swallowing moderately.

On the eleventh day the spasms were fewer and much diminished in severity; he spent a fairly comfortable night and next morning (twelfth day) head retraction and trismus were distinctly less, and the tip of the tongue could be protruded. He had only a few slight spasms during the day. For the first time sedatives were not given and the daily intrathecal injection of antitoxin was omitted; the latter was resumed next day (8,000 units) and given every other day until the nineteenth—viz., on the thirteenth, fifteenth, seventeenth and nineteenth days. From the twelfth day onwards he rapidly improved; up till the nineteenth day a few slight spasms only occurred at intervals, head retraction and trismus gradually diminished, and he was able to take eggs on the sixteenth day. On the twentieth day no spasms occurred and all symptoms seemed to be absent. Next day he was able to open his mouth fairly widely, to protrude his tongue and to flex his head normally.

For the lumbar punctures and serum injections chloroform was the anæsthetic used at the first twelve administrations; on the thirteenth and fifteenth day nitrous oxide was given, while on the nineteenth and last day it was performed without an anæsthetic.

The intrathecal injections of antitoxin were carried out by the gravitation method, using an ordinary funnel and tube; no untoward result, such as respiratory failure, ever occurred. The method is perfectly safe, and as suggested elsewhere with regard to anti-meningococcus serum, Sophian's precaution of registering the blood-pressure as an ocular guide to injection by gravity does not appear to be at all necessary. The end of the bed was raised on high blocks for an hour after each injection to facilitate the upward flow of serum. A serum rash appeared on the tenth day of the disease but never any sign of anaphylaxis. The total amount of anti-toxin given was as follows:—

Intrathecal.

1st to 11th day inclusive—8,000 units per day	..	..	88,000 units.
13th, 15th, 17th, and 19th days—8,000 units per day	..	..	32,000 ..

Intravenous.

1st day—12,000 units	}	..	..	..	..	22,000 ..
2nd day—10,000 ..						

Intramuscular.

1st day ..	..	..	..	..	..	4,000 ..
Total ..						146,000 ..

The serum given intrathecally was Burroughs Wellcome and Co.'s¹ unconcentrated antitoxin (series D, 499c), that given intravenously and intramuscularly being Lister Institute antitoxin (T. 41). Sedatives employed were chlorotone (fifteen to twenty grains) every three or four hours whenever the patient was able to swallow; when unable injections of hyoscine ($\frac{1}{160}$ grains).

At the onset of tetanus an open dressing, consisting of a single layer of gauze, was placed on the wound and kept continually moist with hydrogen peroxide; syringing, also, was frequently carried out with the same fluid. On the third day the wound was considerably cleaner, while on the 7th all œdema had disappeared from its vicinity. Healing was gradual and not complete until nearly three weeks after the final disappearance of the tetanic symptoms. On July 18 (three days

¹ No albumin removed by fractional precipitation.

after the onset of tetanus) cultures from the wound were taken by Mr. Kenneth Goadby. The findings are noted at the end of this communication.

The cerebrospinal fluid showed some points of interest. On lumbar puncture the fluid was allowed to escape until the rate of flow was about six drops per thirty seconds. On the first day fifty cubic centimetres of cerebrospinal fluid were obtained; the pressure was decidedly increased, it was quite clear and its reducing action well marked. The fluid of the second, third and fourth day showed moderate turbidity gradually increasing daily; on standing there was a semi-purulent deposit microscopically consisting of lymphocytes and polymorphonuclear cells and a few lymphocytes. Cultures were sterile, but the fluid did not reduce Fehling's solution. The amount obtained varied from fifty to seventy cubic centimetres per diem. On the fifth day the fluid was again quite clear and remained so until the ninth day, when it showed a distinct yellowish tinge; there was no deposit and the cells were not above the normal in number. The reducing action returned on the fifth day. From the sixth to eleventh day the amount of the cerebrospinal fluid obtained was approximately fifty cubic centimetres at each withdrawal. On the thirteenth day the fluid was again quite clear; twenty-five cubic centimetres escaped on each of the thirteenth, fifteenth and seventeenth days, and twenty cubic centimetres on the nineteenth and last day.

The temperature showed little variation throughout. At the onset it was 97° F., and the pulse 60. During the first eight days the temperature varied between 99° F. and 97° F., averaging normal; there was no elevation while the cerebrospinal fluid was turbid. It reached 100 on four occasions only—on the evening of each of the following days, eighth, tenth, thirteenth and seventeenth, the pulse-rate showing no corresponding rise but remaining under 90. On no occasion did the pulse-rate reach above 100 per minute.

No definite spasms confined to the wounded limb were ever observed. At the onset the knee and ankle jerks were brisk but equal, the right plantar reflex was flexor, and the left (the wounded limb) not elicited even on repeated stimulation. On the fourth day, for the first time, a slight bilateral ankle clonus was obtained; it was not in any sense a continuous clonus but consisted of a few clonic contractions gradually diminishing in intensity. This was present in the right leg for three days, while it persisted in the affected limb (left) for four days longer—the eleventh day, that is, when general improvement was quite decided. In this connexion Goadby [2] mentions a case in which bilateral ankle clonus occurred and persisted for three days longer in the affected limb than in the others.

Both knee and ankle jerks were always slightly brisk but invariably equal.

The left plantar reflex present after the third day was flexor whenever examined; the right gave a flexor response from the onset.

During the stage of abdominal rigidity (first to tenth day), no abdominal or epigastric reflexes were elicited, although Goldschiefer [3] states that they are usually greatly increased. After the eleventh day they were obtained and gradually became brisker. The cremasteric reflexes were present throughout and did not vary. Kernig's sign was obtained until the twenty-fourth day.

As usual in tetanus cases a really definite incubation period is difficult to estimate. Tetanic symptoms appeared during the night of the eighth day of the wound. Browning [1], quoting Peemin and Faber's figures, states that the mortality of cases with an incubation period of less than ten days is 94.7 per cent.

In the present case, it is difficult to be certain how far the exploration of the wound on July 6 was responsible for the awakening of the tetanus which followed fifty-five to sixty hours later. Nivière [4] has found that tetanic symptoms have developed some twelve to forty-eight hours after operative procedures on wounds, and considers the onset determined or accelerated by disturbance of the tissues.

The passive immunity conferred by a dose of anti-serum is said to be of relatively short duration, and it has been found both in the human subject and in animals that the immunity will have fallen to a comparatively low level at the end of a week following the injection (Dehne, Hamburger and Levin, quoted by Browning [1]). In the case recorded above it was practically at this period of low immunity that tetanus developed. It is to be noted that the Special War Office Committee for tetanus have recently (October) advocated the continuance of weekly doses of anti-tetanic serum in cases of severe wounds.

As regards premonitory symptoms, a feature which at present is engaging attention, careful questioning of the patient after his recovery elicited the following only:—

Headache as if face were swollen. Feeling of stiffness at the back of the neck.

He slept fairly well during the night of the onset, no dreams or restlessness occurred and there was no difficulty with micturition.

I have to thank Captain Cronyn, R.A.M.C., anaesthetist to the hospital, and Captain Isaac Jones, R.A.M.C., for their valuable help; my acknowledgments are also due to Sister E. MacRae for the skill with which she nursed the case.

BACTERIOLOGICAL REPORT OF MR. KENNETH GOADBY.

Both upper and lower extensions of the wound were examined.

Direct Films.—(Gram stained). (1) Lower sinus: Cocci, short Gram-positive bacilli, central spore bacilli, Gram-positive (clostridia); no end spore bacilli. (2) Upper sinus: Cocci, diplo- and staphylo-cocci; short, thick Gram-positive bacilli. Cultures were made on: Agar, glucose formate broth, egg broth, meat (the last two under strict anaerobic precautions) from upper and lower sinuses. No end-spore organisms were observed resembling *B. tetanus*.

A good many long, thin Gram-positive threads were seen but no sporulation was observed in these: *B. malignant edema* (Koch), *B. perfringens*, *B. coli communis*, streptococcus (long chained), and *Staphylococcus aureus* were isolated in pure cultures. The cultures were "enriched" in two weeks' time but no *B. tetanus* or any end-sporing organism was observed.

REFERENCES.

- [1] BROWNING, C. H. "Tetanus," *Brit. Journ. Surgery*, vol. iv, No. 13, 1916.
- [2] GOADBY, K. "Treatment of Tetanus," *Practitioner*, May, 1916.
- [3] GOLDSCHIEDER. *Berl. klin. Woch.*, No. 10, 1915.
- [4] NIVIÈRE. *Bull. de l'Acad. de Méd.*, March 30, 1915.

**THE STETHOSCOPE AS AN AID IN THE EARLY DIAGNOSIS OF
GAS GANGRENE.**

BY CAPTAIN B. C. MAYBURY.
Royal Army Medical Corps.

MANY wounds exhibit a varying degree of swelling of the surrounding parts within twenty-four hours of their infliction. In a certain proportion of these cases, especially if the wounds are not drained, the swelling increases and the part becomes infected with gaseous cellulitis, which is recognized clinically by well-known signs, e.g., resonant muscle, characteristic odour, etc. In the remainder, gaseous cellulitis does not develop and the swelling gradually subsides under ordinary treatment.

Crepitations can be detected by auscultation with a stethoscope of the portion of a limb infected with gaseous cellulitis. While this sign is present in a well-established case with "drummy muscles," its importance lies in the fact that it is present in a number of cases before the muscle becomes resonant to percussion, and it is therefore useful in distinguishing between the first group of cases mentioned above and the second.

The sign is produced by placing the stethoscope on the swollen part and then alternately increasing and decreasing the amount of pressure applied to the chest-piece; this produces the necessary movement of the underlying muscle. Another method is to press the swollen part in several places with the finger, while the chest-piece is firmly placed on the centre of the swollen area.

The crepitations thus produced vary in intensity and in number. In the early cases they resemble those heard in the lungs affected with chronic tubercle and may be few in number; in the later cases they are much more numerous. In cases where subcutaneous gas is present, they are much louder and are similar to those heard in ordinary subcutaneous surgical emphysema.

The crepitations may disappear temporarily from a given area, if that area has been manipulated for a short time.

Care should be taken to avoid mistaking the sounds produced by gas from those due to the presence of blood-clot and from those due to friction between the skin or hair and the stethoscope.

The detection of these audible crepitations may be of use in two ways: (1) In cases in which they are present the wound should be more freely opened up than would otherwise be done, and if necessary secondary incisions with free transverse division of the deep fascia should be made into the muscle over which the crepitations have been heard.

(2) During active operations when owing to the large number of cases admitted to the clearing stations it is impossible to drain all wounds involving muscular tissue, cases in which crepitations are present should have preference as regards operation over those in which they are absent.

THROMBOSIS OF CEREBRAL ARTERIES IN PARATYPHOID B FEVER,
OCCURRING IN A GENERAL HOSPITAL IN SALONIKA ARMY.

BY LIEUTENANT H. STANLEY BANKS.

Royal Army Medical Corps.

AND

CAPTAIN H. ROKER EVANS.

Royal Army Medical Corps.

HAVING observed a note on a case of "Thrombosis of the Cerebral Arteries in Paratyphoid B Fever," by Lieutenant Macadam, R.A.M.C., in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS of October, 1916, we think it important to publish a record of a similar case which has occurred in our practice in a General Hospital.

This case, of which we have complete clinical, bacteriological and post-mortem notes, presents two features of interest. It illustrates, in the first place, the severe toxæmic form which this usually mild fever occasionally assumes, and in this connexion we may remark that our patient had not been inoculated against paratyphoid A and B. In the second place, it furnishes another example of arterial thrombosis complicating the disease—a complication which has been rarely noted even in typhoid fever, and which, apart from Macadam's case, has not, so far as we are aware, been described in connexion with paratyphoid fever.

CLINICAL NOTES.

The patient, Second Lieutenant L——, aged 21, was admitted on December 6, 1916, on his third day of illness. He stated that the first symptoms were headache, shivering and diarrhoea. On admission his temperature was 104·8° F. and it remained high and continuous. Blood taken on the fourth day of his disease for blood culture yielded an abundant growth of *B. paratyphosus* B. On the sixth day of illness he presented a typical picture of severe enteric fever, the outstanding features of which were delirium, furred and very dry tongue, and a large crop of small rose spots present all over the trunk. On the seventh day of illness the delirium became extremely violent, and quite unlike the common muttering delirium of enteric fever; it was only controlled by very considerable doses of morphia. On the following days he became quiet and rational, and seemed to be doing well. On the twelfth day, however, he suddenly became unconscious and was then found to have a complete right-sided hemiplegia. He never fully regained consciousness, and death took place forty-eight hours later, the temperature rising to 106° F. before death.

AUTOPSY.

Brain.—The lepto-meninges on the left side were congested, and covered with lymph exudation over the frontal and parietal lobes, a clear line of demarcation being present between the abnormal and normal areas of membrane at the parieto-occipital fissure. The left internal carotid artery was thrombosed where it entered the skull, and the thrombosis extended to the anterior and middle cerebral arteries, making those vessels stand out prominently as hard rounded cords. The anterior cerebral was thrombosed in the first half-inch of its course, and beyond this the vessel and its branches were collapsed. The middle

cerebral was completely thrombosed throughout its course in the Sylvian fissure and the thrombosis involved both its basal and its cortical sets of branches.

The corresponding vessels on the right side of the brain were empty of blood. Around the thrombosed middle cerebral artery there was an elliptical area of cerebral softening, reddish-white in colour, and rather larger in size than a pigeon's egg. It involved both parietal and temporal sides of the Sylvian fissure, the island of Reil, and parts of the basal ganglia and internal capsule.

Spleen.—The spleen was about double its normal size and was deeply congested. *B. paratyphosus* B was cultured from its tissue in great numbers.

Intestine.—The lesions were confined to the lower three or four feet of ileum. The outer coat showed areas of intense hyperæmia at various points, and underlying those areas the Peyer's patches and solitary follicles were inflamed and infiltrated. Ulceration had not taken place. The mesenteric glands were enlarged.

The organs generally were hyperæmic. Both lungs showed congestion and œdema throughout.

The post-mortem findings were typical of a severe general reaction to an intense toxæmia, while the local intestinal lesions, though quite well marked, were not really predominant. The proximate cause of death was the thrombosis of internal carotid and cerebral arteries with the accompanying cerebral softening.

We would note as a further interesting point in connexion with this case the readiness of diagnosis of the condition by the method of blood-culture in the first week of the disease, and the confirmation of that diagnosis by the isolation of the causal bacillus from the spleen after death. Both fermentative and agglutination tests were of course employed in the bacteriological technique.

We desire to thank our commanding officer, Lieutenant-Colonel L. T. Smith, R.A.M.C., for his permission to record this case.

EPITOME OF THE RESULTS OF THE EXAMINATION OF THE STOOLS OF 422 CASES ADMITTED TO No. 3 AUSTRALIAN GENERAL HOSPITAL, CAIRO, FOR DYSENTERY AND DIAR- RHŒA—MARCH TO AUGUST, 1916.

BY LIEUTENANT-COLONEL C. J. MARTIN, F.R.S.

Australian Army Medical Corps.

CAPTAIN KELLAWAY.

Australian Army Medical Corps.

AND

SISTER F. E. WILLIAMS.

Australian Nursing Service.

No. 3 Australian General Hospital being a base hospital, in a large proportion of the 422 cases examined the acute stage of the illness was over and the patients were passing normal or merely loose motions, but in 217 cases the stools contained mucopus in some amount, with or without blood, at the time of the examination. All specimens were examined for protozoological

parasites, but only when mucus was present was the isolation of dysentery bacilli attempted.

The results are analysed in the table below :—

TOTAL CASES, 422.					
<i>Amœba histolytica</i> , or its cysts	72	..	<i>Amœba coli</i>	29	..
			<i>Lambliæ</i> <i>intestinalis</i>	33	..
			<i>Tetramitus</i> <i>mesnili</i>	14	..
			<i>Trichomonas</i> <i>intestinalis</i>	16	..
			<i>Coccidia</i> (isospore)	1	
217 CASES PASSING MUCUS WITH OR WITHOUT BLOOD.					
<i>Amœba histolytica</i> , or its cysts	63	..	<i>Bacillus dysentericæ</i> Flexner group	64	..
			Bacilli indistinguishable culturally from Flexner group	12	..
			<i>Bacillus dysentericæ</i> Shiga	47	

No grounds were discovered for supposing that the protozoological parasites, other than *Amœba histolytica*, were responsible for ill-health.

Twelve organisms isolated culturally and biochemically resembled the Flexner group of bacilli, but failed to agglutinate with any Y or Flexner serum at our disposal. Eight of the strains were retested against the same serum six months later, when five of them agglutinated quite well. These non-agglutinable strains will be described in detail and their significance discussed in another communication.

CONCERNING THE PATHOLOGY AND ETIOLOGY OF THE INFECTIOUS JAUNDICE COMMON AT THE DARDANELLES, 1915.

BY LIEUTENANT-COLONEL C. J. MARTIN, F.R.S.

Australian Army Medical Corps.

Formerly Pathologist to No. 3 Australian General Hospital, Lemnos.

DURING the autumn of 1915 troops at Gallipoli, and to a lesser extent in Egypt, suffered from a nearly non-fatal form of infectious jaundice, usually without complete obstruction of the bile passages, and not associated with any tendency to hæmorrhages. It appeared to be markedly infectious; some units had 25 per cent of their strength affected and many cases occurred amongst patients in hospital for other complaints.

The first case occurred in the French lines on August 10; during September the epidemic slowly spread, until the end of this month, when it rapidly extended, reaching its maximum in the middle of October. During November it as rapidly declined, and was over by the end of the year.

The following is an account of a case of moderate severity. All variations between this and mild jaundice without any obvious signs of illness were common.

The onset is characterized by lassitude, loss of appetite, headache and often suffusion of conjunctivæ. It is ushered in with a brief period of pyrexia, temperature 101° to 102° F., and generally some pain in the upper abdomen. The liver becomes slightly enlarged, can be felt below the ribs, and is tender to the touch. The spleen is sometimes enlarged, but not tender.

These symptoms, except the temperature, which may have returned to normal, are maintained for three or four days, when jaundice occurs and lasts one to two weeks, or longer. The urine is bile-stained, and the pulse often slow, whilst jaundice is present.

By the time that jaundice is developed the patients generally feel better, but weakness continues with rapid pulse and breathlessness on the least exertion.

Seven to ten days after the onset of the disease a distinct increase in the area of cardiac dullness may be made out. Slight albuminuria is not uncommon.

Convalescence is slow and the patient is not good for much for a month or longer.

According to the accounts of the disease published by Sarrailhé and Clunet (1916), Willcox (1916), and by Hurst (1916), the gall-bladder is often, or generally, palpable and tender. Specific enlargement of the gall-bladder was not discoverable in the cases I saw, nor was it in the experience of the colleagues. Sarrailhé and Clunet also record two cases of "ictère grave" which developed in forty-eight hours with high temperature, speedy collapse, purpura, hæmorrhages and death. They do not mention the existence of nephritis.

In opening the discussion on cases of jaundice at Alexandria in November, 1915, Professor Kartulis gave a brief survey of the varieties met with in Egypt and the Levant. He describes two types of epidemic jaundice as not uncommon. The first is a severe disease of sudden onset with rigor, high temperature, intense headache, vomiting and prostration. The liver becomes enlarged and tender and the urine contains albumin and casts. On the fourth or fifth day jaundice appears. Epistaxis, hæmaturia and petechial hæmorrhages are characteristic features. The urine diminishes in amount and the patient becomes unconscious or delirious. Death occurs in thirty per cent or upwards of the cases from uræmia, hæmorrhage or secondary infections. Convalescence is very prolonged.

The milder type described by Professor Kartulis resembles the disease encountered at Gallipoli as described above, but in the Egyptian cases nephritis, epistaxis and petechial hæmorrhages would appear to be more usual symptoms.

Professor Kartulis, using various microscopical and bacteriological methods, searched for the pathogenic agent in both classes of infectious jaundice, but hitherto in vain. He suggests that it must be invisible like that of yellow fever.

The severe form resembles very closely the infectious jaundice prevalent in certain coal mines in Japan which towards the end of 1914 was shown by Inada, Ido, Hoki, Kaneko and Ito (1916) to be caused by a spirochæte. They accordingly named the microbe *Spirochæta ictero-hæmorrhagica*, and the disease spirochætosis ictero-hæmorrhagica. Later Ido, Hoki, Ito and Wani (1916) found the spirochæte in thirty-nine per cent of the rats in the mines and suggest that the miners became infected from these rodents.

Spirochætosis ictero-hæmorrhagica has been also described by Hübener and Reiter (1916), Gwyn and Ower (1916) and Stokes and Ryle (1916), as occurring in the German and British trenches.

In the spirochætal disease, in addition to hepatitis and jaundice, hæmorrhages and an acute nephritis occur. It has a mortality of twenty to thirty per cent, and is apparently dependent upon man's association with rats for its propagation. As described above, the Gallipoli disease was much milder, was apparently more infectious, and there was no reason to suppose that rats contributed to its dissemination. Nevertheless certain striking analogies occur, and the milder type of cases described by Kartulis shows many characters intermediate between our comparatively mild disease and spirochætosis ictero-hæmorrhagica.

Search for the Causes of the Disease.—At Lemnos, in the autumn of 1915, I

was not in a position to make animal experiments, but I hunted for parasites in the blood of early cases, using dark-ground illumination with fresh films and also preparations stained with Giemsa's stain, but without success. I also made blood cultures in eighteen cases, but the only positive result was that I once isolated *Bacillus typhosus*. This patient subsequently went through an ordinary attack of typhoid fever.

The experience of Captain Campbell (1916) at Cape Helles was similar. Captain Campbell made sixty-four blood cultures in non-febrile cases of jaundice and obtained negative results. On the other hand, from nine blood cultures of cases running a continuous temperature he recovered paratyphoid bacilli. In five instances the organism was *B. paratyphosus* B.

Sarrailhé and Clunet had, I understood, found an organism resembling *B. paratyphosus* in the blood in a number of cases of jaundice at Cape Helles and were of opinion that the jaundice was merely a manifestation of paratyphoid fever. I therefore tested the sera of thirty-seven cases two or three weeks subsequent to the onset of an attack of jaundice. Fifteen of the cases had had continuous fever for some time. Out of the fifteen, the sera of seven agglutinated *B. paratyphosus* A and two *B. paratyphosus* B. The sera of the remaining twenty-two cases which had no continuous fever gave no agglutination with either of the paratyphoid bacilli in a dilution of 1 in 50.

As both jaundice and paratyphoid fevers, especially paratyphoid A, were very common at the Dardanelles during October and November, 1915, it is not unreasonable to suppose that in some instances the two diseases were superimposed. As previously mentioned, a number of patients contracted jaundice in the hospital. In some cases the jaundice may have supervened as a complication of paratyphoid, cholecystitis being a not uncommon sequela of this disease. Jaundice, however, is rare.

Another line of inquiry was undertaken at Major Hurst's suggestion, and with his help. Having with him an Einhorn's evacuator, Major Hurst persuaded patients to swallow it, and when it had passed on into the duodenum aspirated a few cubic centimetres of the duodenal contents, which were submitted to bacteriological examination forthwith. Duodenal samples from eight cases of jaundice and from four normal individuals, including Major Hurst and myself, were examined. 0.02 cubic centimetre of the material was plated out upon MacConkey's bile salt agar and also upon ordinary nutrient agar. Samples of the different types of colonies were picked off, sown upon agar slopes and subsequently investigated. The investigation of the cultures was carried out by my colleague, Sister F. S. Williams, for which and for much other help with the observations in this inquiry I am deeply grateful. The results were as follows:—

- 3 of the plates were sterile—2 jaundice and 1 control.
- 9 of the plates grew organisms from 10 to 300 per plate.
- 5 types of bacilli were isolated.
- 4 types of cocci were isolated.

Only one type of microbe was universally present and accounted for the great majority of the colonies. This was a small, non-motile Gram-negative bacillus which fermented no sugar and did not form indol. This bacillus was present in all six of the plates from jaundice cases which grew anything at all, and three of the controls. It is apparently a non-motile member of the *Faecalis alkaligenes*

group common in the upper part of the alimentary canal. On first culture some of these colonies were much denser than others, but on sub-culture this difference tended to disappear.

The remaining types of bacilli were all Gram negative. Their characteristics are given below. Two of these types occurred in Case 5, one in Case 1 and one in Case 8.

Appearance of colony	Appearance of bacillus	Fermentation of sugars					Indol
		Lactose	Glucose	Mannite	Dulcitate	Saccharose	
(A) Translucent ..	Short; non-motile	A	A	A	O	O	O
(B) ,, ..	Short; motile	O	O	A	O	O	O
(C) Dense, white	Short; motile	AG	AG	AG	O	AG	O
(D) Dense, white	Short; motile	O	A	A	O	O	O

The cocci were all Gram positive, with a tendency to form diplococci; two types occurred in Case 4, one in Case 2 and one in Case 5.

Appearance of colony	Appearance of microbe	Fermentation of sugars					Indol
		Lactose	Glucose	Mannite	Dulcitate	Saccharose	
(A) Dense, white	..	O	O	O	O	O	O
(B) Small, glistening	..	O	A	O	O	O	O
(C) White	O	A	O	O	A	O
(D) Large, yellowish	..	A	A	A	O	A	O

The only organism having any general association with the jaundice cases was the bacillus of the *Faecalis alkaligenes* group, and that was equally abundant in the controls. The other microbes were distributed haphazard, so that the results lend no support to the view that the jaundice is due to a microbial infection of the duodenum extending up the bile ducts.

Morbid Anatomy.—As mentioned above, jaundice at Gallipoli was rarely fatal. Three cases died in No. 3 Australian General Hospital, in whom jaundice was still present at the time of death. In two of these the cause of death was cardiac syncope occurring some weeks after the onset of the illness, in the other jaundice supervened during an attack of paratyphoid B fever. Post-mortem examinations were made upon these cases by my colleague Major Upjohn, but as in two patients death occurred during convalescence, and in the case of the third the jaundice might have been a complication of his paratyphoid fever, one cannot expect to derive therefrom much information as to the essential pathology of the disease.

The following is a brief epitome of the notes made by Major Upjohn at the autopsies:—

- (1) A young Maori admitted October 3, 1915, with fever, diarrhoea, abdominal

pain and vomiting. Symptoms maintained until October 10, 1915, when he became delirious and violent, and died on October 11, 1915. Slight jaundice developed a few days before death. Post-mortem: Heart and lungs normal; spleen enlarged. Liver enlarged, yellow, tough; excess of fibrous stroma. Gall-bladder full of bile which could, however, be slowly emptied into duodenum by slight pressure. Small intestine injected, especially Peyer's patches in lower portion; no ulceration. Brain normal. *B. paratyphosus* B was recovered from the spleen and gall-bladder.

(2) Pte. C., aged 41, admitted October 25, 1915, with slight temperature, pain and tenderness over liver, jaundice and great lassitude. November 7, 1915: Convalescing slowly, still weak and breathless. On November 21, 1915, died suddenly during slight exertion. Post-mortem: Patient mildly jaundiced. Heart dilated, flabby, muscle light in colour. Liver usual size and consistency, olive brown in colour; gall-bladder empty. Spleen, normal size and appearance. Intestine normal. Spleen and bile sterile.

(3) Pte. McP., aged 35; suffered from jaundice some weeks previously. Admitted from a convalescent depot, where he had been taken suddenly ill with rapid pulse and breathlessness and pain in right hypochondrium. He died four hours after admission. Post-mortem: Heart dilated and flabby, muscle pale. Liver large, greenish, friable; gall-bladder contained a small amount of bile. Spleen enlarged, soft. Kidneys pale, enlarged and friable. Bile and spleen sterile.

Morbid Histology of the Liver.—The histological changes in the liver of both the cases which died some weeks after the onset of the jaundice attack were similar. In each portal area was small-celled infiltration, together with young fibrous tissue, and large cells full of pigment granules like hæmosiderin. The epithelium cells of the small bile-ducts were proliferated, and many of the ducts appeared not to be patent. Deposits of the same pigment granules existed between the cells.

The outer three-quarters of the liver cells of the lobule appeared normal, but the inner fourth were more or less damaged. The cells immediately adjacent to the intralobular veins were necrosed and indistinguishable as liver cells, more peripherally they were vacuolated. They did not contain fat. Amongst the degenerated cells were a number containing pigment granules. The distribution of this pathological change was not uniform, some groups of lobules being more severely affected than others. There was no dilation of the blood capillaries. No bacteria were seen. Small portions of the liver of both patients were treated by Levaditi's silver method for demonstrating spirochætes. In neither case was there any suggestion of their presence.

The gist of the above results was communicated at the discussion on jaundice at the Anzac Medical Association, Cairo, on February 6, 1916. At that time it did not seem worth while putting them on record, as I expected to encounter the disease again in Egypt the next autumn and to be able to carry out experiments on animals. The disease did not, however, reappear among troops in epidemic form during 1916, so I had no chance of completing the inquiry.

My object in recording them at this juncture is twofold. Firstly, the information may direct future investigators along more fruitful lines of inquiry, and

secondly, because in the meantime conclusions regarding the etiology and pathology of the disease have been published which seem to be open to question.

MM. Sarrailhé and Clunet (1916), the pathologists to the French force at Cape Helles, conclude that the epidemic jaundice at Gallipoli was merely a manifestation of paratyphoid A fever. These gentlemen were in the habit of making blood cultures of suspected cases of enteric, and up to the end of August they recovered only *B. paratyphosus* and *B. typhosus*. At this time they noticed a clinical modification of the (enterica) epidemic. Cases of gastric derangement with fever became less numerous and less severe, many were accompanied by extension to the biliary passages, and numerous cases of jaundice occurred. Coincident with this modification in clinical type the nature of the microbes isolated by blood culture changed. The organism they now recovered corresponded in general characters to paratyphoid bacilli, but would not agglutinate with either their paratyphoid A or paratyphoid B sera of the Pasteur Institute. They provisionally regarded it as a new type, *B. paratyphosus* "D" (= Dardanelles). They state that from nearly all their cases of jaundice, and from those of "gastric derangement with fever" during the jaundice epidemic they found no longer *B. typhosus* and *B. paratyphosus* B, but this atypical variety.

In a later paper (1916 (2)) the authors report the result of the examination of ninety-four of these aberrant strains at the Pasteur Institute. Eighty-four strains were declared to be *B. paratyphosus* A, six *B. paratyphosus* B, and four *B. typhosus*. However, MM. Sarrailhé and Clunet see no reason to modify their opinion that "camp jaundice is merely a hepatic manifestation of the paratyphoid epidemic."

The main epidemiological features described by MM. Sarrailhé and Clunet as occurring in the French lines were repeated at Lemnos, but the same close relationship between jaundice and paratyphoid A was not observed either clinically or in the bacteriological laboratories.

Archibald and his colleagues (1916) at Mudros East found that in September and October the incidence of paratyphoid B steadily rose and was the prevailing type, but about the middle of November the number of cases of paratyphoid A shot up while that of B rapidly fell, the typhoid cases as before remaining low. Our experience at No. 3 Australian General Hospital at Mudros West indicates a more gradual and later change of type. During October, November and December the number of bacteriologically diagnosed cases of paratyphoid A was 83, 76, and 45, of B, 34, 40, and 18 respectively, but after the third week in December only A was met with. Jaundice was first observed in September. In October the number of cases admitted rapidly increased. During the latter weeks of October and early weeks of November it was extremely common amongst troops and hospital personnel stationed at Mudros, and numbers of patients contracted the disease in the hospital.

Judged by admissions to No. 3 Australian General Hospital the epidemic of paratyphoid A was in full swing when jaundice appeared. Some patients suffering from the former undoubtedly had jaundice, but the same was the case with patients suffering from typhoid, paratyphoid B and dysentery, and the impression made upon us was that we were in the presence of two widespread epidemics, one of which was occasionally superimposed upon the other. The same conclusion was arrived at by Lieutenant Campbell from his experience at Cape Helles.

The experience of MM. Sarrailhé and Clunet was evidently different to ours

and it is difficult to disprove their contention. I can only point out that the prevalent type of jaundice at No. 3 Australian General Hospital which is described at the commencement of this paper was not accompanied by a continuous fever, and that paratyphoid bacilli were not recovered from such cases, nor did their sera agglutinate *B. paratyphosus* A or B, although the strains of both these organisms which we employed were readily clumped by the sera of patients suffering from these diseases. Instances such as they record did occur but can, I submit, be more reasonably interpreted as double infections. Paratyphoid fever has been abundantly studied in different parts of the world since its first differentiation by Achard and Bensaude in 1896, but jaundice is surely a rare symptom, for I cannot discover a single recorded instance of its occurrence in the literature.

Another account of the disease given by Major Hurst (1916) seems to me to accept too readily one possible view of its pathology. According to this observer the jaundice is caused by an extension of a catarrhal process from the duodenum, and the enlargement of the liver "must be due to a general infection secondary to that of the alimentary canal."

I am not clear exactly what Major Hurst had in mind in framing the first part of the sentence, but the latter portion is unmistakable. However, Major Hurst is evidently not entirely satisfied with this view, for on p. 106 he admits that it is uncertain whether the primary infection is duodenal or through the blood.

Willcox (1916) also inclines to the opinion that the epidemic jaundice of campaigns starts as a gastro-intestinal infection, that cholangitis follows from spread from the duodenum. This view leads both Willcox and Hurst to the conclusion that infection is conveyed by the alimentary tract.

It is with trepidation that I enter the arena against Lieutenant-Colonel Willcox and Major Hurst when the combat is over matters largely clinical, but it seems to me unfortunate that, in the absence of definite knowledge of the etiology of the disease, these gentlemen should thus light-heartedly throw the weight of their authority in favour of one possible interpretation of its pathology and method of spread. I submit that the picture presented by the infectious jaundice at Gallipoli, the morbid anatomy, meagre as it is, and the negative results of all attempts to discover the infective agent, are at least as consistent with the view that we are dealing with a hepatitis following a systemic infection rather than a catarrhal jaundice from plugging of the bile-ducts from extension of an inflammatory process from the duodenum.

The reasons which influence me in arriving at this conclusion are briefly:—

- (1) The illness is ushered in by a febrile attack like influenza, but usually of shorter duration.
- (2) Jaundice does not occur for some days and is preceded by swelling and tenderness of the liver.
- (3) Bile is rarely completely prevented from entering the intestine.
- (4) The spleen is often enlarged.
- (5) Albuminuria is not uncommon.
- (6) Notwithstanding the comparatively slight initial illness, the existence of a serious toxæmia is indicated by lassitude, which endures for some weeks, and evidence of myocardial poisoning.

(7) Histological evidence of inflammation around the portal areas and necrosis of liver cells.

SUMMARY AND CONCLUSIONS.

- (1) No parasites were discovered in blood films taken during the disease.
- (2) Blood cultures were sterile unless the jaundice supervened during an attack of typhoid or paratyphoid.
- (3) The observations made at No. 3 Australian General Hospital at Mudros do not support the conclusion of MM. Sarrailhé and Clunet at Cape Helles that the jaundice was merely a manifestation of paratyphoid fever.
- (4) Bacteriological analysis of duodenal contents removed from patients affords no justification for the view that the jaundice was due to a bacterial infection spreading up the bile ducts.
- (5) The livers of two patients who succumbed during the convalescent stage of jaundice showed microscopical evidence of hepatitis with necrosis of liver cells.
- (6) It is pointed out that the infectious jaundice of Gallipoli, although much milder, presents analogies to the severer form *Spirochaetosis ictero-hæmorrhagica*, and it is contended that the symptomatology and morbid histology are consistent with the view that it is primarily a systemic infection.

REFERENCES.

- ARCHIBALD, HADFIELD, LOGAN and CAMPBELL (1916). "Reports of the M. and H. Laboratories dealing with Diseases affecting Troops in the Dardanelles," JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, 1916, p. 1.
- CAMPBELL (1916). See ARCHIBALD, HADFIELD, &c., above.
- GWYN and OWER (1916). "Infective Jaundice (*Spirochaetosis ictero-hæmorrhagica*)," *Lancet*, vol. ii, 1916, p. 518.
- HUBNER and REITER (1915). "Beitrage zur Aetologie der weilschen Krankheit," *Deutsch. med. Wochenschr.*, 41, No. 43, p. 1275.
- Idem. (1916). "Beitrage zur Aetologie der weilschen Krankheit," 42 Jahrgang, S. 1; *ibid.* S. 131.
- HURST (1917). "Medical Diseases of the War," London, Arnold, 1917.
- IDO, HOKI, ITO and WANI (1916). "Prophylaxis of Weil's Disease (*Spirochaetosis ictero-hæmorrhagica*)," *Journ. Exper. Med.*, vol. xxiv, p. 470.
- INADA, IDO, HOKI, KANEKO and ITO (1916). "Etiology, Mode of Infection and Specific Therapy of Weil's Disease (*Spirochaetosis ictero-hæmorrhagica*)," *Journ. Exper. Med.*, vol. xxiii, p. 377.
- KARTULIS (1915). "A Discussion on Cases of Jaundice in the Military Hospitals of Alexandria."
- SARRAILHÉ and CLUNET (1916). "La 'jaundisse des camps' et l'épidémie de paratyphoïde des Dardanelles," *Bull. et Mém. de la Soc. méd. des Hôp. de Paris*, 1916, 3 sér., 32me année, pp. 45 et 563.
- STOKES and RYLE (1916). "Note on Weil's Disease (*Spirochaetosis ictero-hæmorrhagica*) as it occurred in the Army in Flanders," *Brit. Med. Journ.*, vol. ii, p. 413.
- WILLCOX (1916). "The Epidemic Jaundice of Campaigns," *Brit. Med. Journ.*, vol. i, p. 297.

¹ Contains a bibliography of the original Japanese publications.

NOTE ON THE EPIDEMIOLOGY OF DYSENTERY.

By H. M. WOODCOCK.

In an article on dysentery in a recent number of the *British Medical Journal* (March 31, p. 418), Captain Carey Evans, I.M.S., concludes that while infection with bacillary dysentery is mainly transmitted by the agency of flies, the amœbic type is chiefly conveyed by water. I was interested in reading this statement because as a result of recent experiences (*vide British Medical Journal*, 1917, i), I had already formed the opinion that in the transmission of amœbic cysts some factor other than or in addition to flies was essential: and a factor, moreover, which is not of nearly such great importance in the spread of bacillary dysentery.

In the area where I have been working flies have been abundant amongst British troops, and bacillary dysentery has been very common, whereas the amœbic type has been quite uncommon. Further, among Indian troops, where amœbic dysentery has prevailed to a considerably greater extent, there has been, nevertheless, practically no increase in the number of infected men, i.e., no spread of the infection; the ratio of amœbic cases to the total number of dysenterics being actually less than the percentage of Indians (twenty per cent) whom I found were normally "carrying" the cysts of *Entamoeba histolytica*. In other words, amœbic dysentery among the Indians has occurred almost entirely in men who were carriers; the hardships and different conditions as regards food, etc., incident to active service in the field have tended in a number of these men to lower their vitality and impair the resistance of the bowel, and as a consequence an attack of amœbic dysentery has resulted.

Wenyon and O'Connor have demonstrated that amœbic cysts can successfully pass through the intestine of the fly, to be voided with the faeces wherever these may be deposited, and have concluded that flies are a very potent factor in the spread of amœbic infection. How is it, then, that flies may be extremely numerous and bacillary dysentery common, while the amœbic type is very infrequent? In the area with which my own work has dealt there has been at all times an ample "reservoir" of cysts among the Indian troops, not to mention an accessory reservoir—of very much less importance, it is true—amongst the native population. It cannot of course be said that sanitation is so perfect that the cysts have no opportunity for dispersal because there is the fact that bacillary dysentery—which is, probably, mainly fly-borne—nevertheless occurs.

Since the ability of flies to carry amœbic cysts was demonstrated, there has been, naturally, a disposition to regard the fly as the essential agent in the spread of this type of dysentery, with the result that the important part played by water has been somewhat overlooked. An essential factor in the spread of amœbic dysentery in a warm climate is the prevalence of moisture and humidity. Without this condition any number of flies are of little avail. Amœbic cysts cannot withstand drying, but on the other hand, as was recently shown by Penfold, Woodcock and Drew (*British Medical Journal*, 1916, i, p. 714) they can retain their vitality—proved by their ability to excyst—in water for at least a fortnight, and probably much longer. I think this fact has a most important bearing on the successful propagation of the species. Now, countries like India and Mesopotamia, for instance, possess, during certain seasons of the year, a very damp climate, with much rain and a high degree of humidity. Hence in these coun-

tries there is an excellent chance for the survival of the cysts deposited in human faeces. Egypt, on the other hand, at all events over large areas, including the Southern Canal Zone where I have been working, is a very hot and dry land with scarcely any rain and a low degree of humidity. A well-known exception is the fringe of coast bordering the Mediterranean, where the temperature is less and the humidity is much greater owing to the moisture-laden northerly winds. Hence one may expect to find a higher percentage of amœbic infections in the northern coastal districts than elsewhere, and the indications are that this is the case. The percentage of carriers among the native population which I have found (about four per cent only) is considerably less than that found by Wenyon, working in Alexandria. Further, I have examined the stools of over fifty Turkish prisoners of war from Arabia and did not find a single amœbic carrier. On the other hand, out of a number of Turkish prisoners and Egyptian Labour Corps men from Mesopotamia, nearly twelve per cent showed cysts of *E. histolytica* in their stools. There can be no doubt that for amœbic dysentery to be prevalent in a particular area the first necessity is plenty of moisture and a high degree of humidity. In a warm, dry climate (or season), notwithstanding an abundance of flies, amœbic cysts have, ordinarily, little chance of survival. It is evident that dysenteric bacilli must be able, on the contrary, to withstand a much greater degree of dryness; otherwise the occurrence of bacillary dysentery in a hot, dry climate is very difficult of explanation.

It remains at present uncertain whether, granted suitable climatic conditions, flies have actually any large share in the spread of amœbic infection. Wet and damp are in the first place less favourable to flies. Further, in such conditions, there is of course far more likelihood of infection by direct contamination, drinking fouled water, and so on. Therefore, while it is quite probable that flies do to some extent act successfully as transmitters of amœbic cysts, I think that water, moisture and humidity constitute a far more important factor in the spread of this infection. And the same is most probably true also in the case of the other intestinal protozoan infections.

Dated April 20, 1917.

Reviews.

MALINGERING OR THE SIMULATION OF DISEASE. By A. Bassett Jones, M.B.Lond., and Ll. J. Llewellyn, M.B.Lond. London: William Heinemann. 1917. Pp. ix and 708.; $9\frac{1}{2} \times 5\frac{3}{4}$. 25s. net.

MALINGERING AND FEIGNED SICKNESS. By Sir John Collie, M.D., J.P. Second Edition. London: Edwin Arnold. 1917. Pp. xvi and 664; 8×5 . 16s. net.

The question of the reality of alleged incapacity due to disease is one which has been forcibly brought before the mind of the public during the last three years. Nothing however was revealed which was new to employers of workmen, the officials of benefit societies, their medical officers, and others in a position to know how bad has been the effect of recent legislation on the essential honesty of the average working man.

Malingering has only been known to the general public as a military offence, but the soldier's efforts in this direction are but feeble compared to the results

gained by the working man. The workman is after all human—very human—and as legislation has made it so much more profitable for him to be sick than at work, there is some excuse for the undoubted fact that his conscience has hardened through temptation so obviously placed in his way.

As a result of the War, another question, that of compensation for disease or disability alleged to be contracted or aggravated by Military Service, has very justly acquired prominence, and a kind and confiding public has rightly demanded that all just claims should be generously dealt with. Ignorance has, however, too often led the public to believe claims to be just where the individual has in fact no shadow of a claim for consideration on the grounds alleged, and this ignorance is going to cost the taxpayer large sums of money during this and succeeding generations, as in the case of the Grand Army of the Republic after the Napoleonic Campaign, and again in the American War.

Hence the importance of these two books on malingering at the present juncture. It is to be hoped that those in authority who have to legislate for, or deal in other ways with these questions will read at least part of each or either of these volumes: even a cursory perusal will show how many-sided the problem is and how difficult to deal with, unless they select a body of well-qualified medical advisors with assessors, and allow them to deal with individual cases without fear or favour.

So well known a book as Sir John Collie's hardly needs notice—except a note of congratulation on the appearance of a second edition. It differs from that by Drs. Bassett Jones and Llewellyn in so far that it appears to be better suited for the use of the layman; it is less technical in some ways and gives full accounts of individual cases.

Drs. Bassett Jones and Llewellyn deal somewhat more systematically and technically with the subject: they include fewer accounts of cases, but give more of the experience of other nations than does Sir John Collie. The two are in a sense complementary.

The preface to a book is too often ignored—but one would call special attention to the first two pages of the preface of the volume by Drs. Bassett Jones and Llewellyn emphasizing the necessity of the employment of all possible knowledge and skill in the attempt to unravel the intricacies of the very difficult problems that too often present themselves, and the necessity of approaching them with a mind free from bias.

R. J. S. S.

THE WOUNDED FRENCH SOLDIER. By Dion Clayton Calthrop. Published in aid of the French Red Cross. The St. Catherine Press, 34, Norfolk Street, Strand, London. Price 1s. 6d.

A charming series of pen pictures of scenes behind the French lines—full of pathos, and vividly illustrating the endurance and bravery of the French men and women.

Each chapter repays re-reading and conjures up in one's mind a picture of what the French Nation is enduring. I will give one short quotation:—

"I have followed you soldiers of France from post to post and I have seen your courage and the courage of your doctors. And inch by inch you must be cared for, and that care needs money."

Buy this small book; it is good value and you help the French Red Cross.

LORD LISTER. By Sir Rickman John Godlee, Bart., K.C.V.O., M.S., F.R.C.S. London: Macmillan and Co., 1917. Pp. xix and 676; 9 × 5½. Thirty-three illustrations.

Lord Lister was great in many ways—as surgeon, physiologist and bacteriologist, and not least as a man. A reasoned review of his life should be written by a syndicate, and based at least as much on his "Collected Papers" as on this

very charming account by Sir Rickman Godlee, whose purpose has been to let the world "know something of the inner life of one who achieved so much on its behalf." This life has been written for "those chiefly interested in him as a man"—and in the more technical portions for his professional brethren.

The present reviewer's only excuse for his attempt is that while technically a medical student, but before formally beginning his medical curriculum, he once saw Lister operate in the Old Infirmary at Edinburgh, and a little later worked the spray and carried out the ritual of these days under a sceptic, Professor "Jimmie" Spence—one was therefore not very far removed from the Dark Ages. Although the conditions at that time were much more favourable than had been the case a few years before, it does not appear that any written account can convey a sense of the enormous importance of Lister's work to anyone who had not experience of surgical work in the late seventies and early eighties. The diminishing band of teachers and students of that period are probably those only who can appreciate the change.

As the personal impression of one who was never in actual contact with Lister and whose only source of knowledge was that open to all—gossip, the general and technical press—one felt that apart from his special work there was a peculiar charm about the man—a combination of strength of character with the devotion to duty of a modest and retiring man. Sir Rickman Godlee's *Life* only intensifies this impression, or perhaps one should say, gives solidity and colour to a faint outline.

This is a book to be read, bought and preserved.

R. J. S. S.

HYGIENE AND PUBLIC HEALTH. 6th Edition. By Dr. Louis C. Parkes and Dr. H. R. Kenwood. Published by H. K. Lewis and Co., Ltd., 136, Gower Street, London, W.C. Pp. xii and 787. Size demy 8vo. Price 14s. net.

The present edition of this standard work has been revised and brought up to date. New matter in the shape of a comprehensive survey of Maternity and Child Welfare Work has been added; and the subjects of Personal Hygiene, Camp Sanitation and Communicable Diseases have been amplified. A note on Marine Hygiene has also been inserted.

The work is so well known that a detailed review is unnecessary. At the same time we cannot help expressing some disappointment that the opportunity afforded by a new edition has not been made better use of to give in much fuller details the essentials of camp and permanent hutment sanitation, which the needs and experience of the past three years have evolved. The treatment and disposal of all sullage water from large military camps present difficulties which do not arise in civil life, particularly with respect to the elimination, saving and purification of fats. Indeed, this problem might well be considered in its application to civil life, when it is realized that thousands of pounds worth of valuable by-products are every day shot into the sewers, not only to be wasted, but also to occasion vast increased expenditure at the disposal works.

With the military and civil population so closely related owing to billeting, and quartering in hired houses, there is greater need of co-operation between the military and civil health officers than in peace time, but this edition contains no mention of the sanitary provisions and precautions which are necessary when buildings are taken over for the accommodation of troops probably until the close of the demobilization period.

In the chapter on Food, the subject of food values has been exhaustively dealt with. It is suggested that a summary in the shape of a table of (quantity) comparative diets be included in the next edition. These should indicate the appropriate quantities for children, adolescents and adults; the latter under full manual work, light work and sedentary occupations.

In the section on cooking fuller information is needed, particularly as to the

principles involved in the treatment of fish and vegetables, and the recovery of fat. The principles involved in preparing soups, stews and braises should also be described.

In the chapter on Communicable Diseases, the introduction of plates showing the phases in the life-history of the malarial parasite, and the naked-eye appearance of the anopheles and culex would be helpful. For it must be realized that with the return of so many malaria-infected soldiers to this country, it is not unlikely that the former mosquito may become an infecting agent.

In the excellent note on cerebrospinal meningitis the disinfection of carriers in a "special inhalatorium" is mentioned, but in addition a description of this method is required. It is worthy of note that a routine of subjecting recruits, especially soldiers with colds, to the inhalatorium, is gradually being adopted in some of the larger receiving depots with satisfactory results.

The remarks on "carriers," especially enteric carriers, are most apposite.

The type is bold and clear, the index comprehensive, and the subject matter well arranged.

A. B. H.

LABORATORY STUDIES IN TROPICAL MEDICINE. By C. W. Daniels, M.B.Camb., F.R.C.P.Lond. and H. B. Newham, M.D.Durh., M.R.C.P.Lond., M.R.C.S.Eng., D.P.H.Camb., D.T.M. and H.Camb. Fourth edition, London: John Bale, Sons, and Danielsson, Ltd., 1916. Pp. xv and 560; $8\frac{1}{2} \times 5\frac{1}{2}$. 2ls. net.

Good wine needs no bush—and when a well-known and admired book like this reaches a fourth edition, all that need be said is to congratulate those interested in its subject on the opportunity afforded them of obtaining an edition revised and brought up to date as has been done in this volume.

Further, it is to be recommended most thoroughly to the considerable body of medical men who are now making their first acquaintance with tropical disease.

AMBULANCE No. 10. By Leslie Buswell. London: Constable and Co. Pp. xi and 155; $7\frac{1}{2} \times 4\frac{3}{4}$.

A record of the work of an American Ambulance, in the form of private letters. First printed for private circulation, and later republished for sale in the United States.

It gives interesting personal experiences of the earliest period of the War, and does not pretend to do more. Interesting and effective as far as it goes.

APR 26 1918

No. 2.

February, 1918.

Vol. XXX.

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL W. H. HORROCKS, C.B.

ASSISTED BY

LIEUT.-COLONEL D. HARVEY, C.M.G., R.A.M.C.

ISSUED MONTHLY



Printed and Published by

JOHN BALE, SONS & DANIELSSON, LTD.

OXFORD HOUSE

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

Price Two Shillings net.

THE TREATMENT OF VENEREAL DISEASES.

**Recurrent Fever
SYPHILIS**

GALYL

**Framboesia
Sleeping Sickness**

Practical work with GALYL in the shape of **60,000 INTRAVENOUS** (dilute and concentrated) and **INTRAMUSCULAR INJECTIONS** administered in Military, Naval, and the principal General Hospitals throughout the United Kingdom, has demonstrated that this preparation is **more rapid and less toxic** in action than any compound of the "606" group, which accounts for the **consistently excellent clinical results** without any undesirable by effects.

The other advantages of GALYL are:

1. Distilled water only necessary for making the solution.
2. GALYL can be injected in the dilute or concentrated form—**intravenously**—or in Glucose Solution—**intramuscularly**.
3. GALYL is a true Anti-syphilitic, as shown by the results of the Wassermann test, but contains a smaller percentage of Arsenic than any of the compounds of the "606" group.

Forms:

FOR INTRAVENOUS INJECTIONS:—

(1) **DILUTE**.—GALYL is supplied in neutral glass ampoules containing the necessary dose of Sodium Carbonate, sterile distilled water only being used for the dissolution.

(2) **CONCENTRATED**.—A special outfit containing one dose GALYL, one ampoule sterilised solution, and one small filter is supplied.

Doses:—

0.10 — 0.15 — 0.20 — 0.25 — 0.30 —
0.35 — 0.40.

(3) FOR INTRAMUSCULAR

INJECTIONS:—

GALYL is supplied in **GLUCOSE SOLUTION**.

Doses:—

0.10—0.15—0.20—0.30—0.40

LITERATURE, CLINICAL REPORTS, and PRICE LIST on REQUEST.

THE ANGLO-FRENCH DRUG CO., Ltd. (Late M. Bessillon & Co.),
Camage Building, Holborn, London, E.C.

Telephone: Holborn 1811.

Telegrams: "AMPSALVAS, LONDON."

The TREATMENT OF CARBUNCLES, BOILS, ANTHRAX,
ACNE, STYES, and Diseases arising from Staphylococcus.

STANNOXYL

(An Oxide of Tin and Tin Metal Free from Lead.)

A scientific production the value of which has been studied very closely. The effect is very prompt; from the second day of treatment the pain is relieved, the carbuncles begin to dry up, and those which are just opening are stopped in their course; the core is not expelled but reabsorbed.

In the majority of cases definite results are obtained within five or six days; it is seldom necessary to take the full ten days' treatment, and relapses are unknown.

The daily dose for adults is 4 to 8 tablets; children 2 to 4 tablets.
Supplied in vials of 80 tablets.

The SCIENTIFIC TREATMENT of INFLUENZA and Allied Ailments.

KINECTINE

According to Dr. MOUKEYBAT, the discoverer of Galyl (the widely adopted Salvarsan Substitute).

FORMULA:—Chlorhydrate of Quinine c. Hectine—i.e., Benzo-sulfone-para-amino-phenyl-arsenate of Quinine.

Non-toxic, produces no ill results. Easily taken (tablets) and well tolerated.
Highly satisfactory clinical results.

Not only a prophylactic against, but a specific in **INFLUENZA, MALARIA, Catarrh, Coryza, NEURALGIA, HAY FEVER, &c.**

Sir,—I enclose P.O. for the tube of Kinctine. The drug has given every satisfaction.
The Anglo-French Drug Co., Ltd., Holborn, London, E.C.

H.M.S. — 27.7.17.

W. B. H. W., Surgeon, R.N.

Journal
of the
Royal Army Medical Corps.

Original Communications.

A STUDY OF THE MECHANISM OF THE AGGLUTINATION AND ABSORPTION OF AGGLUTININ REACTION, TOGETHER WITH AN EXAMINATION OF THE EFFICACY OF THESE TESTS FOR IDENTIFYING SPECIMENS OF THE MENINGOCOCCUS ISOLATED FROM 354 CASES OF CEREBROSPINAL FEVER.

BY CAPTAIN WILLIAM J. TULLOCH, M.D.

Royal Army Medical Corps.

Lecturer on Bacteriology, University of St. Andrews.

INTRODUCTION.

At the present time, owing to the difficulties arising from war conditions, and the stress of work due to the special circumstances in which the study of bacteriology is being prosecuted, we have had in some cases to modify established methods of bacteriological procedure and introduce new technique.

The difficulty of obtaining an adequate supply of pure carbohydrates for performance of sugar tests, and the even greater difficulty of obtaining men trained in laboratory work in bacteriology, has hastened this change in general procedure to a very considerable extent. It is important that the nature—so far as this is susceptible of examination in the present state of our knowledge—and limitations of procedures which have in the past been commonly made use of, or have recently been introduced, be carefully scrutinized.

Such scrutiny would serve the useful purpose of preventing undue enthusiasm for, and its converse, unmerited condemnation of, methods which, when correctly appreciated and properly carried out, afford valuable information.

In the following paper the first three sections are devoted to a

116 *Agglutination and Absorption of Agglutinin Reaction*

consideration of the mechanism and limitations of the agglutination phenomenon, and of the absorption test. The last section (four) is occupied with an analytical survey of the actual result of application of the agglutination test—checked in a large proportion of the cases by the absorption test—to over 300 specimens of meningococcus isolated from the cerebrospinal fluid of cases and examined at the Central Laboratory, up to the present time.

In order fully to appreciate the potential errors of the agglutination phenomenon, and its amplification, the absorption of agglutinin test, in their application to the identification of micro-organisms, and the establishment of the relationship which they bear to disease processes, it is essential that the factors concerned in the mechanism of these reactions should be borne in mind.

Our knowledge of these reactions has progressed considerably of recent years, and I think that we may fairly state now that the views of Ehrlich, in respect of the phenomenon under consideration, are no longer tenable. The same may be said of the theories advanced by Gruber and Durham, Nicolle, Paltauf, and Dineur, to explain the clumping of micro-organismal suspensions when exposed to the action of corresponding anti-sera.

The view advanced by Bordet that the process of agglutination occurs in two distinct phases, viz.: (1) the union of antigen with antibody; (2) the flocculation of the united antibody antigen "couple" by the electrolytes of the fluid in which the reaction is carried out, has never been controverted, but, on the contrary, has been corroborated by all the experimental work carried out since Bordet's original discovery.

I shall, therefore, discuss the problem of agglutination from the standpoint of Bordet.

In the process of agglutination three separate systems react with one another, the antigen, the antibody and menstruum in which these are suspended; and the reaction is divisible into two phases of:—

- (1) Union of antigen with antibody.
- (2) Flocculation of the "antibody-antigen complex."

SECTION I.

POINTS TO BE NOTED CONCERNING THE UNION OF ANTIGEN WITH ANTIBODY.

- (a) *Influence of the Reaction of the Menstruum in which the Reagents are suspended.*

Two of the interacting substances, the antigen and the antibody, are, so far as is known, of the nature of complex colloids. The complexity of these colloids is further enhanced by the fact that the active bodies are probably only constituents of still more complex systems. The conditions, therefore, which determine the union or interaction of antibody with antigen are not so far susceptible of complete investigation. Nevertheless,

there is evidence that this union occurs only under certain definable conditions. Thus, in the case of organisms of the colon-typhoid group at least, it will not take place if the fluid be too acid or too alkaline, i.e., the interaction of the two "active" colloids is determined to some extent by the reaction of the menstruum, and it appears to take place most readily when the suspending fluid is isoelectric with the mixture of colloids.

The following simple experiments illustrate this point :—

To investigate the action of acid on the process of sensitization a mixture of organisms was suspended in saline with HCl present in a concentration equal to N/100 and sensitized with specific agglutinating serum, titre 1/8000, in concentration of 1/100. The mixture was allowed to stand at room temperature for forty-eight hours; it was then centrifuged at high speed to deposit the bacteria. The supernatant fluid was drawn off and the deposit washed with distilled water. The material was washed twice in this way and then suspended in distilled water. This suspension was added to a series of tubes containing the following reagents in such concentration that, with the addition of the bacillary emulsion, the concentrations shown in the following table were obtained.

TABLE I.—*B. paratyphosus* B AND ITS HOMOLOGOUS SERUM (HCl N/100).

Electrolyte		N/20	N/100	N/1000	N/10000	N/100000
NaCl	—	—	—	—	—
Na ₂ SO ₄	..	—	—	—	—	—
BaCl ₂	..	—	—	—	—	—

Note.—In the above table and in all those which follow :—

+ = Agglutination.
 — = No agglutination.
 ? = Doubtful result.

The tests were done using macroscopic method, the volume in each tube being 1 c.c. In the experiments with *paratyphosus* the readings were made after two hours at 37° C.; with the *meningococcus* after twenty-four hours at 55° C.

Control experiments with a number of strains of the same and other organisms showed that when sensitization was carried out with sera of much lower titre, 1/2000, in absence of acid the organisms agglutinated readily in all cases at a concentration of NaCl, equal to N/100. The converse of the above experiment using NaOH gave a similar result.

If the reaction of the menstruum then be too acid or too alkaline the union of antigen with antibody is inhibited, and no complex being formed, the system is not susceptible to the flocculating action of electrolytes.

Certain colloidal complexes appear to be more susceptible than others to this disturbing influence, and on this account great care should be taken to prevent the introduction of technical errors.

(b) Influence of the Electrolytes of the Menstruum.

There is some evidence too (unpublished investigations on biological lysis of red blood cells deprived of their electrolytes by prolonged washing in isotonic sugar solutions) that the formation of an antibody-antigen "couple" is also conditioned by the presence of dissolved salts in the menstruum and that the result obtained depends largely on the nature of the electrolytes in the fluids employed for suspending the reagents. In these experiments it is of course essential that all the fluids used be isotonic with the red blood cells. The "inactive" diluents employed by me in these experiments are solutions of glucose or saccharose.

The work of Pauli (*Zeit. Chem. Ind. Koll.*, 1908, iii, 2) on the relation which the concentration of electrolytes bears to the coagulation temperature of protein points in the same direction, for it will be seen from the second section of the present communication that the behaviour of sensitized organisms—i.e., antibody-antigen "couple"—strongly recalls the reactions of denaturated proteins, and Pauli's investigations indicate that the process of denaturation also is to some extent conditioned by the presence of salts. It is interesting to note that Pauli's work calls attention to the fact that the reaction between salt and protein in this connexion is probably of the nature of a surface condensation.

(c) Influence of the presumably inactive Constituents of the Antigen and Antibody Colloids upon the Process of Sensitization.

It must be clearly understood that the active substance of (or the peculiarly active physical state of) the serum, or of the organismal colloids, that leads to the initial sensitization in the process of agglutination, does not necessarily include all the constituents of the serum or of the organism.

The (presumably) inactive substances may be present in such quantity or in such a physical state that they protect the united antibody-antigen complex from the flocculating action of electrolytes. I conceive of certain examples of the "negative phase phenomenon" in agglutination as being due to such a mechanism. The following is an example of such a negative phase reaction with the serum of an animal (rabbit) on being immunized with meningococcus, Type III.

TABLE II.—SERUM OF RABBIT "C" IN COURSE OF IMMUNIZATION.

	$\frac{1}{25}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{800}$	$\frac{1}{1600}$
Coccus used for immunization	—	—	+	+	+	Trace

It is to be noted that after being stored for some time this particular serum no longer exhibited a negative phase.

(d) *The Quantitative Relationship between Antigen and Antibody in the Process of Agglutination.*

The quantitative relationship between antigen and antibody in the process of agglutination is of considerable moment, in view of the fact that upon this directly depends the validity of the absorption of agglutinin test in its application to bacteriological research.

Mainly owing to the work of Eisenberg and Volk, this relationship is now known to obey the same laws as those governing the phenomenon of adsorption or surface condensation.

When a foreign substance is introduced into a two-phase "colloid solution" it tends according to its physico-chemical attributes to distribute itself throughout the system in a peculiar way. Often it will be found to condense itself on the surface of the disperse phase.

For example, if gum arabic be introduced into a tube containing suspended particles of finely divided barium sulphate in water (such a suspension of barium sulphate may be regarded as a suspensoid colloid, admittedly of large particle, dispersed in the water) the gum condenses on the surface of the particles of BaSO_4 (barium sulphate), and a complex of "barium sulphate plus gum" is formed. It may be noted in this instance that the gum arabic acts as a protective colloid and inhibits the sedimentation of the BaSO_4 due to gravity.

The amount of foreign substance which a disperse phase can adsorb depends, *ceteris paribus*, upon the extent of the surface which it presents for the foreign substance to condense upon.

The law which governs this process is of wide application in physical chemistry and is applicable to the adsorption of hydrogen and other gases by carbon at different pressures, and the adsorption of dissolved substances from various strengths of their aqueous solutions by the same reagent. The law holds good for solutions of any substance in a variety of solvents.

The amount of gas adsorbed, or the quantity of solute removed from a solution by carbon, does not increase either in proportion to the pressure under which the reaction is carried out, in the former instance, or to the concentration of the dissolved substance in solution in the latter. The amount of gas, or material adsorbed from solution, increases much more slowly in proportion than the increase of pressure exerted, or the heightening of concentration of solute in the fluid.

In the agglutination reaction we introduce serum—a foreign substance—into a two-phase system consisting of bacteria dispersed in saline. Such suspensions of bacteria have properties akin to those of non-rigid or emulsoid colloid solutions.

In many respects bacterial suspensions recall solutions of fresh proteins and are flocculated like these by high concentrations of ammonium or magnesium sulphate. Like the proteins too, certain suspensions are flocculated by one concentration of those reagents, while similar

120 *Agglutination and Absorption of Agglutinin Reaction*

suspensions of other micro-organisms require higher concentrations of these salts to bring this about.

The foreign substance, serum, distributes itself between the saline and the bacteria and, if a sufficiently large bacterial surface of the requisite character be available, the whole of the serum will be condensed thereon. If the surface be not sufficiently extended, a certain amount of serum will remain unattached and will be demonstrable in the fluid after removal of the antibody-antigen complex by centrifuging.

The following table from Eisenberg and Volk (*Zeit. Hyg.*, 1902, vol. xl, 155) calls attention to the adherence of this reaction to the law of adsorption, as the figures of Column II are in remarkable agreement with those in Column III, the former of which indicate observed results while the latter give the results as calculated on the general formula of adsorption.

The figures of Column I represent the amount of agglutinating serum, estimated in arbitrary units, exposed to adsorption by a given (arbitrary but constant) quantity of emulsion of the homologous organism. Those of Column II indicate the potency of the demonstrable remaining "agglutinin" observed in the fluid after the serum and organisms have interacted. The potency of the agglutinin is expressed in terms of the same unitage as in the figures of Column I. Column III indicates the potency of agglutinin which should be present after the reaction if the union of antigen and antibody were strictly amenable to the law of adsorption. Column IV indicates the quantity of agglutinin adsorbed, expressed as percentages of the amount exposed to the adsorbing action of the organismal suspension.

TABLE III.

Column I	Column II	Column III	Column IV
Units of agglutinin exposed to absorption	Units observed after absorption	Units which ought to be demonstrable after absorption. Calculated on the "Adsorption Formula"	Units absorbed (observed) expressed as percentage of that exposed to absorption
2	0	0.02	100 per cent
20	0	0.7	100 "
40	0	2.1	100 "
200	20	19.7	90 "
400	60	52.9	85 "
2,000	500	478	75 "
10,000	3,500	3,890	65 "
20,000	9,000	9,160	55 "

The above results are so striking that they scarcely call for comment; but the importance of the findings cannot be exaggerated. It is obvious that the absorption of agglutinin test is limited in its application, and that extreme care must be exercised in its technique if reliable results are to be obtained.

Attention is here called to the qualification noted in the previous

paragraph, viz., that the condensing surface must be of the requisite character, that is, that the suspension must be homologous with the serum to be adsorbed.

It is this which introduces that factor in the phenomena of immunology, specificity, concerning which we remain in complete ignorance.

Until the conditions which determine the specificity of serological tests are known, all the so-called immunity reactions must remain fundamentally empirical, so that at present their value as an aid to the further investigation of bacteriological problems can only be gauged by the results obtained.

I might also call attention here to the fact that in addition to the specific adsorption of an antibody to its homologous antigen, there may sometimes be some non-specific condensation of antibody upon heterologous antigen or other disperse phase suspended in the menstruum to which the serum is added. It follows that in carrying out the absorption of agglutinin test one must bear in mind the possibility of thus introducing avoidable error; the test must be performed under such conditions that:—

(a) The serum is sufficiently dilute;

(b) That the emulsion of organisms is sufficiently dense to bring about complete absorption of specific antibodies, but

(c) That the emulsion is not too dense, lest it introduce error owing to aspecific condensation of the serum.

The import of these points will again be noted in considering the practical application of the absorption of agglutinin test, for it will be seen from the later sections of the present communication that it is necessary to elaborate a special technique for every variety of organism, or rather for every group of organisms that one proposes to examine.

(e) *Analogies between the Union of Antibody with Antigen and Certain Experiments of Colloidal Chemistry.*

Gengou in an illuminating article (*Arch. Intern. Phys.*, 1908, vol. vii, fasc. 1 and 2), on the subject of molecular adhesion, calls attention to certain important points. He shows, for example, that the apparently different and opposed phenomena of dispersion and agglutination may be due to one and the same mechanism. Those colloids which are in themselves stable bring about dissociation of material suspended in fluids, while unstable colloids added to the same suspension may bring about its flocculation. This point will be further considered in the second part of this article, which deals with the purely physical factor of agglutination—i.e., precipitation.

One point of great import having its counterpart in the phenomenon of agglutination is, that when a colloid is adsorbed to a suspension of, for example, barium sulphate, there results a “BaSO₄ colloid complex.” If the fluid containing such a complex be centrifuged, it is found that the

deposit obtained consists of the whole complex and not of either constituent alone.

The supernatant fluid is inert and will no longer bring about either dispersion or flocculation, as the case may be, of further quantities of BaSO_4 suspension that may subsequently be added to it, provided that the quantity of adsorbable colloid added in the first instance is not too large. The law governing adsorption in general is applicable to these complexes.

An especially interesting point may here be noted, namely, that the complex of a colloid adsorbed to a suspension may have a very different effect upon that suspension than the colloid alone.

Of this phenomenon Gengou also cites an excellent example: Gum arabic added to suspensions of BaSO_4 markedly stabilizes these and renders them relatively insusceptible to gravity. On the contrary, the " BaSO_4 gum complex," obtained by centrifuging such a mixture, brings about very rapid flocculation of further suspensions of barium sulphate in water subsequently added to it. In the first experiment, sedimentation of the barium is inhibited owing to the particles of that substance being protected one from another by a coating of gum and, as the gum shows no tendency to flocculate, the suspension is stable. In the second experiment, on the contrary, each droplet of gum with its nucleus of BaSO_4 forms a particle on the surface of which the BaSO_4 , which is further added will be adsorbed and condensed.

This second quota of BaSO_4 is, however, unprotected, and is therefore liable to flocculate, which it will do all the more rapidly because the particles of the system are much larger and heavier than before, and do not now show the mutual repulsion for one another exhibited by the droplets of gum.

I call attention to these points as they serve to illustrate how apparently paradoxical may be the interaction of relatively simple colloidal systems with one another, and to indicate the paramount necessity for special care being observed when carrying out tests in which the interacting systems appear to be almost infinitely complex, as is the case in the immunity reactions.

(f) *Influence of the Physical State of the Reacting Systems upon the Union of Antibody with Antigen.*

In Section I, Subsection (b), of the present communication, attention is called to the fact that sensitized organisms—serum-organism "complex"—behave in certain cases as does denaturated protein. It is remarkable that in respect of agglutination, if either of the interacting colloids be denaturated by heat prior to their being mixed together, agglutination may not take place. Indeed, serum exposed to relatively high temperature may even develop inhibitory properties, thus Priestly (*Journ. Hyg.*, 1917, February,

p. 500) finds that if agglutinating sera be heated to certain temperatures, which vary according to the serum under investigation, temperatures between 60° C. and 70° C. for thirty minutes, they may no longer produce agglutination of emulsions of the homologous organism in any dilution; the same serum heated to 75° C. for a similar time may become not only inactive but even inhibitory, and will interfere with the agglutinating power of the (same) unheated serum.

If it be exposed to a still higher temperature it fails to produce agglutination, and further, it loses its inhibitory property.

The same is true to some extent of bacteria. Thus Eisenberg and Volk (*Zeit. f. Hyg.*, vol. xl., 1902) find that bacteria heated above 65° C. may no longer agglutinate in presence of immune serum. This seems to be true of most organisms; it has been my experience with representatives of the colon-typhoid group of bacilli, meningococci and *B. tetani* when heated to 75° to 80° C. for thirty minutes.

I conceive of this alteration in agglutinability as depending upon an alteration in the physical state of the reagents. Its import cannot be over-rated, for it implies that there are different optimum conditions for the demonstration of each type of reaction between antibody and antigen, so that here again the essentially empirical nature of the agglutination test is emphasized, until, at least, these optimum conditions have been determined in respect of the particular complex that is under investigation.

What precisely happens on "overheating" an antibody or an antigen it is difficult to say, and in the first instance—overheating of the serum—the problem appears incapable of solution by simple experiment. Michaelis, Eisenberg and Volk, and Bail, have, however, demonstrated that it is the process of flocculation, and not that of the union of antigen with antibody, which is thus inhibited.

In the latter case—"overheating" of the antigen—it seems that the modification of the antigen is such that the complex which it forms with the serum is not susceptible to flocculation by electrolytes. That the anti-bodies of the serum unite with the organisms is shown by the fact that they are removed by absorption with emulsions of "overheated" bacteria.

The following experiment illustrates this phenomenon in the case of the meningococcus.

An emulsion of meningococcus (a Type III coccus was used) standardized to contain 4,000 million cocci per cubic centimetre, was divided into two portions, A and B.

A was exposed to a temperature of 65° C. for thirty minutes, and B to a temperature of 80° C. for the same time.

Each was then used for saturating a specimen of Type III serum, following the standard technique.

The following day agglutination and saturation experiments were set up with A and B, the following results being obtained:—

TABLE IV.

	Unsaturated serum				Saturated serum. Coccus added was heated 30 minutes at 65° C.			
	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
Coccus heated 30 minutes at 65° C. ..	+	+	+	+	—	—	—	—
Coccus heated 30 minutes at 80° C. ..	+	—	—	—	—	—	—	—

Note.—The temperature to which the organism must be exposed and the time during which it is exposed thereto varies considerably. Some emulsions are more susceptible than are others to the influence of heat. This probably depends on the reaction of, and the electrolytes present in, the menstruum. Pauli's work on the coagulation of the proteins would lead one to expect such variation.

The complexity of the whole mechanism is further enhanced by the fact that agglutininogen so called is not a definable substance. All organisms contain—in terms of the nomenclature used by Ehrlich and his followers—more than one agglutinin-producing antigen, as is shown by Joos (*Cent. f. Bakt.*, vol. xxxiii, 1903). This author shows that in the case of *B. typhosus* one of these antigens or a group of them, is thermostable and another, or others, thermolabile. Even more important than the finding of Joos are those of Scheller (*Cent. f. Bakt.*, vol. xxxvi, 1904, and vol. xxxv, 1905) that heated bacteria may absorb agglutinins from the sera with more avidity than do emulsions of the same organisms when they have not been heated.

The influence, then, which previous heating exercises upon organisms that are to be agglutinated is not unimportant. Heating to certain temperatures may enhance both the power which a given suspension of organisms has of combining with antibodies, and the flocculability of the complexes which the organisms form with these, while heating to 80° C., although it does not necessarily inhibit the formation of a "complex," may inhibit flocculation.

The conditions under which such heating, before exposure of the suspension to the agglutinating serum is carried out, are important. A saline suspension heated to 65° C. is agglutinable in the case of most organisms, but a similar suspension heated to 65° C. in saline containing 0.5 per cent pure phenol may not flocculate on exposure to the same serum.

The assumption that there is a multiplicity of agglutinogenic antigens in one organism, as conceived by Joos, renders the whole subject of agglutination unnecessarily complex. If it be true, it is not improbable that the optimum conditions for the flocculation of one particular antigen-antibody complex will differ from the optimum conditions for the flocculation of another, although the two antibodies are each constituents of the same serum, and the two antigens constituents of the same organism.

In another connexion the (assumed) "multiplicity" of so-called agglutinin-producing antigens is of importance, for the more specific response on the part of an animal to inoculation with emulsions of certain organisms occurs more readily than the less specific or group response.

There is really another explanation for this which is dealt with in Part II.

This is particularly true of meningococcus and is to a less extent true of *B. tetanus*. For this reason in working with these organisms I invariably employ only the serum of animals whose course of immunization has not been prolonged beyond ten days.

A similar fact, and one of considerable importance, particularly in the study of the pathogenic anaerobes, is that if an animal be immunized with mixed cultures of certain organisms, the antibodies for one of the organisms comprised in the mixture may be demonstrable in the blood serum of the animal some days before those corresponding to the others are manifest.

It has so far been my experience—although this is admittedly limited—that the response of the animal to the more pathogenic constituent of the mixture occurs earlier and is more easily demonstrable than is the response to the less pathogenic constituent.

SECTION II.

THE SECOND PHASE OF AGGLUTINATION.

The second phase of the agglutination test, that of demonstrating the formation of a complex by its flocculation, is relatively simple compared with the first phase. Experiments conducted with a view to its elucidation in the case of organisms of the colon-typhoid group show the mechanism of flocculation, of sensitized bacteria in this group to be similar to that concerned in the aggregation of suspensions to certain denaturated proteins.

It must be remembered in this connexion that different proteins react differently in the presence of various reagents, as is shown by Chick and Martin (*Journ. Physiol.*, 1912-1913, vol. xlv, pp. 261 and 295). These authors demonstrate that the aggregation of particles of denaturated egg-white is conditioned by the presence of electrolytes and by the range of hydrogen-ion concentration over which the reaction is extended.

The same is true of the aggregation of particles of denaturated serum protein, but the figures applicable to egg-white are not applicable to serum protein, etc.

In the case of serum protein, the flocculation of the particles occurs when electrolytes are present in low concentration, and if these be raised to certain concentrations which bring about aggregation of egg-white, no aggregation of serum protein occurs.

In the same way it is highly probable that certain antibody-antigen complexes are much more susceptible to the flocculating, or to the dispersing, power of electrolytes than are other similar complexes—that is, "similar" only in that they consist of other organisms which have adsorbed their homologous antibodies.

Considering, then, the second phase of the reaction, one may ask the questions: "Why is it that a suspension of organisms remains more or less stable until the organisms are sensitized?" "When the organisms are sensi-

tized, what is the mechanism which determines their clumping together in masses sufficiently large to render them susceptible to gravity?"

As Liefman has shown (*Cent. Bakt. Par.*, ref. 75, 14, 1913) unsensitized organisms are flocculated only by the process of salting out by means of highly concentrated solutions of magnesium sulphate and ammonium sulphate and therein resemble natural proteins.

Their resemblance to fresh proteins is all the more marked in that some species of organisms are precipitated by certain concentrations of these reagents, while others require stronger solutions to bring this about.

Sensitized organisms—serum-organism complex—on the contrary, behave like denaturated proteins and, like rigid colloids, are susceptible to flocculation by low concentrations of salts.

The unsensitized organisms in a suspension are repelled by, and themselves repel, those adjacent to them by virtue of their carrying a surface electric charge according to the Lippman-Helmholtz hypothesis. The conditions which bring about the neutralization of this charge will determine the flocculation of the suspension.

The charge carried by protein particles in suspension depends in kind and in degree upon:—

- (1) The reaction of the menstruum in which they are suspended.
- (2) The electrolytes present.

In inquiring into the second phase of agglutination, therefore, the relation which these two factors bear to one another must be considered and the relation which each, or both, bear to the degree of sensitization to which the organisms have been subjected. Furthermore, the influence which other physical conditions may have upon the process must not be lost sight of.

(a) *Influence of the reaction of the suspending fluid, in which the interacting bodies are dispersed, upon the process of flocculation, and influence of the valency of the electrolytes upon the process in presence of acid and alkali.*

Considering these questions *seriatim*, it is found that the reaction of the suspending fluid exerts a marked influence on the phenomenon under consideration. This would naturally be expected in view of the fact that the surface charge carried by particles of protein—organisms may be regarded as large protein particles—in suspension depends for its sign upon the acidity or alkalinity of the fluid. When the menstruum is acid the particles carry a positive charge, and when alkaline a negative charge.

The following tables illustrate experiments designed with a view to showing the influence of acid and alkali upon the process of agglutination of sensitized bacteria.

Method.—A twenty-four hours' agar culture of *B. paratyphosus* B is washed off in saline and exposed at 22° C., or 37° C. for twenty-four hours, to the action of 1 1000 antiparatyphosus B bacillus serum of titre 1/8000.

The supernatant fluid is pipetted off and the deposit washed by centri-

fuging at least twice in distilled water. The deposit is then suspended in distilled water, filtered to remove any gross particles that may remain and exposed to the action of NaOH in varying concentration in presence of a number of electrolytes, each of which was, when all the reagents were mixed, equimolecular with 0.9 per cent NaCl. The following table shows the readings of this experiment after two hours at 37° C :—

TABLE V.
Complex-constant.
Electrolyte-constant.
Hydroxide ion-variant.
Two hours at 37°.

No NaOH control				1 c.c.	0.9 c.c.	0.8 c.c.	0.7 c.c.	0.6 c.c.	0.5 c.c.	0.4 c.c.	0.3 c.c.	0.2 c.c.	0.1 c.c.
NaCl	+	—	—	—	—	—	—	—	—	—	+
K ₂ SO ₄	+	—	—	—	—	—	—	—	—	—	+
KI	+	—	—	—	—	—	—	—	—	—	—
NaHCO ₃	+	+	+	+	+	+	+	+	+	+	+
Na ₂ HPO ₄	+	+	+	+	+	+	+	+	+	+	+

This experiment shows that the hydroxide ion interferes with the process of flocculation, and that a relatively small concentration of that ion has a marked inhibitory effect. The results with NaHCO₃ and Na₂HPO₄ show that if replaceable hydrogen be present in the electrolyte this inhibitory effect is negated.

The converse of this experiment is shown in the following table. The organisms were sensitized with 1/100 serum, then washed twice as before and exposed to the action of varying proportions of N 50 HCl in presence of the electrolytes named.

TABLE VI.—*B. paratyphosus* B AND HOMOLOGOUS SERUM.

Complex-constant.
Electrolyte-constant.
Hydrogen ion-variant.
Two hours at 37°.

N 50 HCl				1 c.c.	0.9 c.c.	0.8 c.c.	0.7 c.c.	0.6 c.c.	0.5 c.c.	0.4 c.c.	0.3 c.c.	0.2 c.c.	0.1 c.c.
Electrolyte N/20													
NaCl	—	—	—	—	—	—	—	—	—	—
Na ₂ SO ₄	—	—	—	—	—	—	—	—	+	+
"Na ₂ cit." (neutral)	+	+	+	+	+	+	+	+	+	+
BaCl ₂	—	—	—	—	—	—	—	—	—	—

Note.—The citrate result is "falsified" in respect of the influence of valency owing to the replaceable Na of the salt.

It may be noted that the above results indicate that the inhibitory effect of hydron is more marked in the presence of monovalent anions than in the presence of divalent anions. The reason for this will be considered later.

I have purposely omitted from this section of the work a detailed consideration of the influence of polyvalent kations or anions upon the process of flocculation, as these are somewhat difficult to investigate. The polyvalent kations have much the same influence upon unsensitized organisms as they have upon sensitized organisms, owing probably to the formation of metal hydroxides in the system in the form of precipitable gels. The polyvalent anions also present difficulties owing to their dissociation; thus, using citrates, if a neutral solution of the salt be employed the following difficulty arises: the effect of acid cannot be readily estimated owing to the presence of available hydroxide which will neutralize the acid, while the effect of alkali is also masked, owing to the presence of replaceable hydrogen groups.

The mechanism whereby electrolytes bring about the precipitation of sensitized organisms is explicable on the basis that they neutralize the surface charge carried by the particles. It follows, therefore, that the precipitating ion in the case of acid suspensions of protein is the anion; while in that of alkaline suspensions it is the kation. It is interesting to note that Burton (Univ. Toronto, Stud. Phys. Lab., 36) found that the addition of aluminium ion to hydrosols of gold or silver in certain concentrations leads to the precipitation of the metal from its sol; lower concentrations of the Al. ion did not have this effect, and the particles of the sol in the case of the metals under consideration (which bear a negative charge) continued to move in the same direction in an electric field as before, *but at a diminished rate*. If concentrations of Al. ion, greater than that required to bring about the precipitation of the sol, were employed, the particles remained dispersed, but their direction of movement in the electric field was reversed, showing that they had now become positively charged.

In the case of the copper sols, which carry a positive charge, exactly the opposite was noted; polyvalent anions in this case lead to precipitation and ultimately, if added in sufficient concentration, to dispersion, accompanied by a reversal of surface charge as evidenced by reversal of direction of movement in the electric field.

The relative precipitating value of uni-, di- and tri-valent kation in respect of negatively charged colloids and of uni-, di and tri-valent anions in respect of those bearing a positive charge may be expressed according to Linder and Picton (*Journ. Chem. Soc.*, 1895, 66 and 67) by the formula: $1 : \times : \times^2$.

We have evidence that, in the case of sensitized bacilli of the colontyphoid group at least, the precipitating value of salts obeys in general the same rules in respect of valency, although the actual figures applicable to the precipitation of colloidal As_2S_3 (the reagent used by Linder and Picton) by electrolytes are not applicable to the flocculation of serum-organism complexes. These facts show that in acid suspension or in alkaline suspension, sensitized bacteria behave as do denaturated protein particles, and

the results obtained agree in principle with the findings of Hardy (*Journ. Phys.*, xxiv, p. 170, and *Proceed. Roy. Soc.*, 1900, lxvi, p. 101), and of Chick and Martin (*Journ. Phys.*, xlv, p. 261).

I here recall the fact that these authors show that the precipitation of denaturated egg-white is determined by somewhat different physical conditions from those that bring about precipitation of denaturated serum protein. It follows, therefore, that the optimum conditions for the flocculation of each type of "antigen-antibody complex" would have to be defined before the most specific agglutination results could be obtained. Here again the essentially empirical character of the agglutination test, as ordinarily performed, is manifest.

The following tables illustrate the influence which divalent kations, as contrasted with univalent kations, have upon the process of flocculation of sensitized organisms bearing a negative charge. A suspension of *B. paratyphosus* B was sensitized for twenty-four hours at 37° C. in presence of 1/1000 antiparatyphosus B serum, titre 1/8000. The sensitized organisms were washed by centrifuging in two changes of distilled water. Thereafter the deposit, consisting of sensitized bacilli, was triturated, filtered, and exposed to the action of the following reagents in such concentrations that when the bacillary suspension was added the salts were present in the strengths shown in the following tables:—

TABLE VIIa.

Electrolytes	Dilutions of Electrolytes					
	0.5/N	0.1/N	0.01/N	0.001/N	0.0001/N	0.00001/N
NaCl	+	+	+	—	—	—
Na ₂ SO ₄	+	+	+	—	—	—
"Na ₂ Cit" (neutral)	+	+	+	—	—	—
BaCl ₂	+	+	+	+	—	—

TABLE VIIb.

Electrolytes			Dilutions of Electrolytes													
			0.005/N	0.001/N	0.0003/N	0.0002/N	0.0001/N	0.00009/N	0.0008/N	0.0007/N	0.0006/N	0.0004/N	0.0003/N	0.0002/N	0.0001/N	0.00009/N
NaCl	+	+	+	+	+	+	+	+	+	+	+	+	+	+
KCl	+	+	+	+	+	+	+	+	+	+	+	+	+	+
CaCl ₂	+	+	+	+	+	+	+	+	+	+	+	+	+	+
SrCl ₂	+	+	+	+	+	+	+	+	+	+	+	+	+	+
BaCl ₂	+	+	+	+	+	+	+	+	+	+	+	+	+	+
MgCl ₂	+	+	+	+	+	+	+	+	+	+	+	+	+	+

130 Agglutination and Absorption of Agglutinin Reaction

The divalent kations are much more potent than are the univalent kations. It is to be noted that the converse of this experiment is also true, viz., that in "acid" suspensions the divalent anions produce flocculation more readily than do the univalent anions.

(b) *The Relation which exists between the Degree of Sensitization and the Precipitating value of the Electrolytes present in the Menstruum.*

This point is of considerable importance, especially if a proper appreciation of the absorption of agglutinin test is to be obtained. The following example indicates that this relationship is not a simple one, and serves to call attention to its important bearing upon the question under consideration.

If emulsions of *B. aertrycke* and *B. paratyphosus* B be exposed to a serum specific to either, it not infrequently happens that both organisms are equally well agglutinated. One may describe such a finding thus: that both *B. aertrycke* and *B. paratyphosus* B form with, e.g., anti-*paratyphosus* B serum, complexes which are flocculable by 0.9 per cent NaCl.

It does not necessarily follow, however, that these two complexes are identical, and if one can show that the complexes differ from one another the validity of the absorption test, in its application to the identification of micro-organisms, is much enhanced. In effect the proposition is: Does *B. paratyphosus* B form exactly similar (that is similar from the standpoint of flocculation) complexes with its homologous serum as does *B. aertrycke* with the same, and therefore heterologous serum?

TABLE VIII.
Two hours at 37°.

NaCl					
N/20	N/40	N/100	N/200	N/400	Serum
+	+	+	+	+	1/100
+	+	+	+	+	1/500
+	+	+	+	?	1/1000
+	+	+	?	—	1/2000
+	+	?	—	—	1/4000
—	—	—	—	—	1/8000

BaCl ₂					
N/400	N/500	N 606	N/1000	N 2000	Serum
+	+	+	+	+	1/100
+	+	+	+	?	1/500
+	+	+	—	—	1/1000
+	+	—	—	—	1/2000
+	—	—	—	—	1/4000
—	—	—	—	—	1/8000

A priori one might hazard a guess that this query is to be answered in the negative; for, were it answered otherwise, the absorption of agglutinin

test would be inexplicable. By varying both the dilution of a serum and the concentration of electrolytes in which an agglutination is carried out, it can be shown that a whole series of complexes, varying in their susceptibility to flocculation, may be formed when an organism is exposed to the action of its homologous serum. The table on p. 130 illustrates an experiment of this kind, in which both serum and electrolyte are variants, while the organismal suspension is a constant.

This experiment shows that an organism can form, along with its own antibody, a variety of complexes differing *inter se* in their susceptibility to flocculation. These complexes cannot be regarded as different in kind, but only in degree. Is it not highly probable then that the complex formed by union of an organism with an heterologous antibody would differ markedly from that obtained by interaction with the homologous antibody?

Light could be thrown on this problem by setting up an experiment in which the suspension of organisms and the serum remain constant, the only variant being the concentration of electrolytes. The following experiment illustrates this:—

Method.—Equal volumes of standard suspensions of *B. aertrycke* and *B. paratyphosus* B were each sensitized in presence of anti-aertrycke and anti-paratyphosus B sera. The agglutinated bacilli were washed twice in distilled water, shaken and filtered through paper to produce a homogeneous suspension which was then “dispersed” in distilled water. Thereafter each of the emulsions so obtained was exposed to the influence of varying concentrations of NaCl and of BaCl₂. The following results were obtained.

The results obtained using BaCl₂ are not shown in the following table. They fully corroborate those obtained with NaCl.

TABLE IX.
One hour at 37°.

Serum	NaCl	N/20	N/40	N/80	N/100	N/200	N/400
Anti-aertrycke.. ..	<i>B. aertrycke</i>	+	+	+	+	—	—
	<i>B. paratyphosus</i> B (titre of serum = 1/2000)	?	—	—	—	—	—
Anti-paratyphosus B..	<i>B. aertrycke</i>	+	+	+	—	—	—
	<i>B. paratyphosus</i> B (titre of serum = 1/8000)	+	+	+	+	+	+

Note.—When a simple agglutination was set up in saline with the above organisms in presence of homologous and heterologous sera, it was found that the anti-aertrycke serum agglutinated the aertrycke bacillus and *B. paratyphosus* B equally well and vice versa.

The result indicates, I think, that serum and electrolyte being constant, the physical properties of what might be termed a “co-complex” differ from those of what might be called a “specific complex,” the latter being

132 *Agglutination and Absorption of Agglutinin Reaction*

more susceptible to the flocculating action of electrolytes. This result also bears a striking resemblance to Pauli's investigations noted in Section I, of the influence which salts have upon the heat coagulation of protein, for it appears that the salts in Pauli's experiments play a double rôle :—

- (1) By influencing the process of denaturation and
- (2) By determining the occurrence of actual flocculation.

The relation which the valency of the precipitating ion of the electrolyte bears to the titre of the serum here calls for attention. If a number of electrolytes equimolecular with NaCl 0·9 per cent be used in place of that salt, it is found that none of them increases the titre of the agglutinating serum, as is shown by the following table illustrating such an experiment :—

TABLE X.—*B. paratyphosus* B.
Two hours at 37°.

Electrolyte equi-molecular with 0·9 per cent salt	Dilutions of serum						
	1/100	1/500	1/1000	1/2000	1/4000	1/8000	1/10000
NaCl	+	+	+	+	+	+	—
NaF	+	+	+	+	+	+	—
Na ₂ SO ₄	+	+	+	+	+	+	—
K ₂ SO ₄	+	+	+	+	+	+	—
Na ₂ CO ₃	—	—	—	—	—	—	—
Na ₂ HPO ₄	+	+	+	+	+	+	—
BaCl ₂	+	+	+	+	+	+	—
"Na ₃ Cit" (neutral)	+	+	+	+	+	+	—
Aq. Dest. ..	+	—	—	—	—	—	—

Note.—The positive result obtained with 1/100 dilution of the serum in water is probably due to the salts that the serum contains.

On comparing this result with that indicated in Table VII one sees that as one approaches that dilution of serum which might be called its "threshold value" the electrolyte has to be added in greatly increasing concentration, in order to bring about aggregation of the bacteria.

Thus in Table VII it is seen that BaCl₂ brings about flocculation in concentration N/400 in presence of 1/4000 serum, while an increase in concentration of the same salt to N/6·5 does not show marked increase in the titre, which is apparently the same as that with NaCl 0·9 per cent.

(c) *Effect of other Physical Factors upon the Second Phase of Agglutination.*

It might be expected that the surface tension (intrinsic pressure) and viscosity (internal friction) of the menstruum, would influence the process of flocculation because of the important rôle which these play in determining the disposition of particles in suspension. It has been found, however, that, within fairly wide limits, provided the electrostatic conditions of the particles in suspension do not show alterations concomitant with variation

of these, they in themselves have but little effect in enhancing or inhibiting the aggregation of sensitized bacteria.

One point which is so obvious that it may easily be forgotten, is drawn attention to by Gengou—that if the particles deprived of their surface charge are to come together to form flocculi, they must not be too far dispersed from one another in the suspension, for, under such circumstances, their coalescence will be delayed and the initial lag in this phase of the reaction may be lengthened beyond the time allowed arbitrarily in the laboratory for the demonstration of agglutination. Admittedly this must occur but infrequently. Nevertheless, attention is called to it because it substantiates the plea that to be of value for comparison the agglutination test must be carried out under standard conditions. One of the most easily standardized factors in the process is the bacterial content of the emulsion employed.

The temperature to which the reagents are exposed before or during the test is also of moment, for variation of this condition may well affect both phase 1 and phase 2 of the reaction.

I have already discussed how it may influence the union of antigen and antibody. Its influence on the process of flocculation is even more striking, for it may affect this in two distinct ways :—

(1) By producing a continuous movement of the interacting bodies in the suspension.

(2) By encouraging, or inhibiting, owing to its altering the physical state of certain complexes, their precipitation by electrolytes.

Considering these factors in more detail, the following points appear :—

(1) It is known that gentle shaking of an antibody-antigen complex suspended in saline will hasten in a remarkable manner the process of flocculation. This hastening of the process is probably due to the fact that shaking brings the particles of the suspension closer together and makes one particle roll over the other. As these particles are no longer mutually repellent, they tend to coalesce, and having once coalesced remain together unless violently dispersed by rough handling.

If the reaction be carried out at 55° C. I have observed that the convection currents in the tubes are more active than if the test be made at 37° C. These convection currents have exactly the same effect as gentle shaking of the tubes, and are not too active at this temperature to break up the flocculi. The higher temperature therefore is, *ceteris paribus*, a more satisfactory one at which to perform the test than is body heat; provided always, of course, that the possibility of introducing an experimental error due to this elevation of temperature is borne in mind, and such error eliminated before incubation at the higher temperature is adopted as a routine procedure.

(2) The mechanism whereby the higher temperature enhances flocculation depends on the fact that certain proteins are more easily flocculated after exposure to an increase in temperature varying according to the

134 *Agglutination and Absorption of Agglutinin Reaction*

particular protein under examination; they are in fact altered somehow in respect of their physical properties.

Gengou, in the article already quoted, gives a striking example of this. If unheated serum be mixed with a suspension of BaSO_4 , the serum stabilizes the suspension; but if the serum be previously heated to 65°C . it induces rapid flocculation of suspensions of the same substance. In the former instance, the serum, adhering to the BaSO_4 , and itself showing no tendency to flocculate, protects the BaSO_4 , so increasing the stability of the suspension.

In the latter instance, on the contrary, the serum does tend to flocculate of its own accord, and adhering to the particles of BaSO_4 it brings about rapid sedimentation of these. The rapidity of sedimentation is especially noticeable in the case of substances like BaSO_4 which are heavy, and remain in suspension in water only for a limited time, and only if the particles which form the suspension be sufficiently finely divided.

One would naturally expect then that as proteins are rendered more susceptible to flocculation by elevation of temperature, the formation of certain complexes, while not demonstrable at 37°C ., might well be demonstrable at, for example, 55°C . This is particularly likely to be the case, for the process of sensitization, i.e., the formation of a complex, as we have seen, is akin to the process of denaturation.

There is an obvious criticism to the employment of the higher temperature for agglutination. Does the reaction remain specific under the new conditions brought about by the change from 37°C . to, e.g., 55°C .? The answer to such criticism is to be sought by experiment and in experience.

If a sufficient number of organisms be investigated under the new conditions, if a sufficiency of controls be included in the experiments—always especially bearing in mind the employment as a control of a normal serum of the same species of animal as that used for preparing the agglutinating serum—if the results obtained are corroborated by the absorption of agglutinin test, the new conditions may be found to be valid in that they yield specific results.

From this again it can be seen that the test is empirical, for until we know the optimum conditions for the demonstration of agglutination in respect of these factors, the value of the agglutination and the absorption of agglutinin tests for the identification of micro-organisms, can only be established on results obtained.

SECTION III.

PRACTICAL CONSIDERATIONS AND DISCUSSION.

The points raised in Sections I and II of this communication indicate that the whole process of agglutination depends upon a number of finely balanced physico-chemical reactions. The formation of a flocculable "complex," and its sedimentation, are both governed by physical forces,

and it is apparent that the fine balancing of these forces may in some instances be of paramount import—if consistent results are to be obtained.

In carrying out the agglutination test and the absorption of agglutinin reaction, it is essential that those factors which are susceptible of standardization be standardized; especially in view of the complexity of certain of the reagents employed.

(1) While serum cannot be standardized satisfactorily, as its activity can only be estimated in terms of purely arbitrary units, I think that it is advisable to employ only the serum of animals whose course of immunization has been of short duration.

(2) To use only a serum which is found to react consistently with several representative strains of each serological type of organism which it is proposed to investigate, and

(3) To elaborate a standard routine technique and scrupulously to adhere thereto throughout each series of experiments which are to be compared one with another. The standards adopted for the examination of one group of micro-organisms may differ considerably from those adopted for the study of another group, e.g., typhoid technique differs somewhat from that used for tetanus.

The standardization of technique involves:—

(a) The employment of sera of approximately equal titre in all experiments dealing with allied organisms. The titre selected for one species would not necessarily be that selected for another, but in respect of all members of one group the titration of the serum to a definite point should be rigidly adhered to.

(b) The use of standardized suspensions of organisms of approximately definite bacterial content and always prepared in exactly the same way, both for the agglutination test and for the absorption of agglutinin test.

The need for the exercise of such care in the preparation of the suspensions is emphasized by the findings of Scheller (*Cent. f. Bakt.*, xxxvi, 1904, and xxxviii, 1905), who shows that higher agglutination titres are obtained with *B. typhosus* previously heated to 65° C. than are obtained by the same organism unheated. Further, these heated bacilli are more avid of antibodies than are the unheated organisms.

(c) Saline or other electrolyte employed should be made only with distilled water, and, as it is easily prepared, should be made up freshly each day.

(d) The nature of the medium on which the cultures are made, especially the standardization of the reaction, should be noted and care should be taken to avoid injuring the medium. It is also advisable to get rid of condensation water before proceeding to wash off the growth. The reason for these precautions is that if the medium be alkaline there is danger that a too alkaline suspension be obtained, and so inhibit the reaction. If medium, especially agar, be present in the suspension, it is conceivable that it may act as a protective colloid, and so may inhibit both the union of the antigen with antibody and the process of flocculation.

(e) I have found that, when performing the absorption of agglutinin tests in the examination of meningococci, it is advisable to use freshly prepared sera, as these give clearer cut results than do sera which have been in store for some months, even under the best conditions. The reason for the discrepancy between freshly made sera and those that have been stored I cannot suggest and am not at present in a position to explain.

(f) If carbolized suspensions are used the strength of the phenol should not be greater than 0.5 per cent. It should only be added after the emulsion is heated—if heated emulsions are employed—and only the purest phenol can be added to suspensions if comparable results are to be obtained.

The results quoted in Sections I and II of this communication show why we are compelled to standardize the reagents and the procedure of the reactions under consideration, owing to the errors which are liable to be introduced, were such not done.

If the standards just laid down be adhered to, the results obtained over long periods are found to be comparable with one another and, notwithstanding the apparent complexity of the tests, they are relatively easily carried out and give consistent results after a certain amount of experience has been obtained. Indeed, when the necessary experience has been obtained they are carried out more easily and quickly than are fermentation tests, for these call for extreme care in the isolation of cultures and in the assessment of the results given by growth in the carbohydrate media. When a positive reaction is obtained in the case of a fermentation test, one must be assured that the result is due to the organism under examination and not to a contamination. Any one who has been engaged on the study of certain groups of bacteria, and notably on a study of the anaerobes, cannot but be deeply impressed with the possibility of error due to this cause in case of inexperienced workers. On the other hand, when a negative result is obtained in the case of a carbohydrate test, one must be satisfied that not only did the inocula live in the sugar medium, but that multiplication took place. These points can only be verified by subculture and re-isolation, which occupies valuable time, and the results obtained are worthless unless the investigator be highly skilled.

It has been my experience that, when my agglutination tests have given unsatisfactory and discrepant results, some detail of my technique has been at fault and a repetition of the test with rigid attention to detail always resulted in consistent findings being obtained.

It will be noted that the question of specificity has not so far been discussed in the present communication, for reasons indicated in the introductory paragraph. I wish to point out, however, that the theory of specificity of serum reactions, which, consciously or unconsciously, dominates nearly all the writings on the subject, is the purely philosophical hypothesis of Ehrlich. This savant visualized organisms as consisting of a number of definite "antigens," certain of which are common to each member of a group of organisms and others specific to individual members

(serological types) of the group, in exactly the same way that he visualized each type of antibody as having a peculiar chemical structure. Thus an "agglutinin" was diagrammatized as having a combining chemical group and a flocculating chemical group; and an "amboceptor" as having one group which combined with "antigen" and another with complement. Whenever a new phenomenon was demonstrated in serology, it was only necessary to add another side-chain, or construct a new diagram, and the new reaction was explained.

According to this view, each of the antigens of one organism is assumed to be able to call forth, when that organism is inoculated into an animal, a response specific to itself, and the antibodies for each are assumed to be chemically different one from another.

Such an assumption is not by any means necessarily valid, and indeed, if we assume without question its validity, it follows that the experiment described in Section II, subsection (b) (Table VIII) of this article, would indicate that the complex formed by *B. paratyphosus* B with 1/100 dilution of its homologous serum in presence of NaCl, N/400, might differ not merely in degree, but in kind, from the complex resulting from the union of the same quantity of the same emulsion with 1/4000 dilution of the same serum in presence of the same electrolyte, or with N/20 NaCl in presence of the lower dilution of the serum.

I conceive, therefore, of group reactions being due possibly, not to closely allied organisms having a definite group antigen common to all the members of the group, but to each member of a group of allied types or related species consisting wholly of specific antigens, which however form complexes with heterologous sera more or less easily flocculated in presence of certain concentrations of certain salts, depending upon how close or how remote the relationship may be between the serum and the organism forming the complex.

To conjure up a new antigen common to all those members of a group of organisms which happen to react with one serum, and to extend the process indefinitely as has been done in order to explain why sera are not strictly specific, lays the whole subject of agglutination and other serological tests under suspicion. The same objection may justifiably be made to such reasoning concerning the multiplicity of antigen in one organism as Bordet, rightly I think, advanced in his criticism of the whole side-chain theory of immunity. Bordet says: "Everyone agrees naturally that the numerous antibodies which the study of immunity has brought to our knowledge and which are active on such different elements as bacteria, cells, toxins and the like, should not be considered as identical, inasmuch as they may be distinguished as regards specificity, or in other words, since they unite with different antigens. But, in addition to this incontestable difference of specificity, Ehrlich has imagined another one which is more far-reaching and which deals with the molecular structure of the antibody. Indeed he classes these antibodies in accordance with their molecular

structure into three genera: antitoxins with a single combining group, agglutinins and precipitins with a single combining group and an additional functional group which brings about agglutination or precipitation; and finally sensitizers which have two combining groups in their molecules, uniting on the one hand with the cell that is affected and on the other side with the alexin (complement), and hence the name of amboceptor.

"In every instance, according to this classification, the phenomena observed are attributed to special properties in the antibody and never to those in the antigen. As a matter of fact, these phenomena should be related not as regards antigen or antibody considered separately, but as regards the complexes which result from their union, and it is evident that the special properties of the antigen must affect markedly and perhaps to a preponderating degree the qualities of such complexes."

It is apparent from this quotation that Bordet's attention is focused especially upon the antibody. But when the above was written the evidence was not clear that the same criticism could be applied to Ehrlich's conception of antigens. Indeed, Bordet apparently agrees to some extent with Ehrlich's view, or at least he does not specifically refute it, that there may be a number of *definite* and therefore chemically different agglutinogenic antigens in one variety of micro-organism. In view, however, of the more recent findings in the study of the physico-chemical aspect of the subject of serology, it is quite logical to apply the same reasoning to the antigen as Bordet applies to the antibody. Further, in view of the results indicated in Section II, subsection (b) of this communication the application of the criticism is even wider than that indicated by Bordet in respect of antibodies, since it can be applied to the discussion of the mechanism of agglutination in the presence of heterologous serum in contrast to that in presence of homologous serum.

Regarded superficially, this concept would appear to invalidate the application of the absorption of agglutinin test to the identification of micro-organisms. For, if a complex be formed, the flocculation of that complex should result in removal of antibody from the fluid, as stress has been laid upon the fact that neither organism nor serum is flocculated in the process of agglutination, but that the floccules consist of both serum and organism in some form of physico-chemical combination.

Far from invalidating the test, however, this argument could be used further to establish its value. It is known that some complexes are especially easily flocculated under certain circumstances, and that in such cases only a very low concentration of antibody requires to be united with the organism in order to determine the formation of a complex flocculable in presence of, e.g., 0.9 per cent NaCl. The results obtained, performed with suspensions made in saline, indicate, therefore, that the degree of adsorption of antibody by heterologous mixtures is much less than by homologous mixtures, and indeed, in most cases, the adsorption which occurs with heterologous mixtures is almost negligible. This really means

that phase I. of the agglutination test is always specific, while phase II. shows specific results only if the physical conditions of the experiment are such as to allow of the specificity of phase I. being demonstrated.

SECTION IV.

RESULTS OBTAINED IN APPLYING THE AGGLUTINATION AND THE ABSORPTION OF AGGLUTININ TEST TO THE INVESTIGATION OF GRAM-NEGATIVE COCCI WHICH PRODUCE PRIMARY MENINGITIS IN MAN.

In view of the fact that the validity of applying the agglutination and absorption of agglutinin tests to the demarcation of the meningococcus group of organisms, and to the differentiation of these *inter se*, may be regarded as debatable, I think it would be of some interest to give a summary of the results obtained in the examination by the methods in question of a consecutive series of this organism obtained from the cerebrospinal canal.

We may divide those results into those which are quite specific and show that the organisms under examination when tested by means of the agglutination method, using the four type sera of Gordon, react with one and with only one of these, and those which are not specific, the organisms reacting with more than one of the type sera.

(a) *Results which are absolutely unequivocal in respect of the Four Type Sera.*—Provided that the sera issued by the Central Cerebrospinal Fever Laboratory for the investigation of epidemic meningitis among troops were absolutely specific, and if these sera represent all the organisms which might be designated meningococci, every specimen of coccus isolated from the cerebrospinal fluid in cases of the disease should, when tested with these sera, give a reaction corresponding to one of those symbolized as *a*, *a1*, *a2*, etc., in the following table. No specimen should be met with giving a reaction corresponding to that symbolized as *X*.

It is, however, too much to expect of this, as of any biological method of investigation, that the experimental error will be completely eliminated. It would indeed be surprising if the Gram-negative diplococci which produce primary meningitis did not show relationship one to another when tested by biological methods.

Of the 356 cocci investigated by the agglutination test in the Central Laboratory, 234 gave absolutely specific results as follows:—

(1) Fifty-four different specimens gave a positive reaction to a dilution of 1/400 with Type I serum only.

(2) Thirteen reacted with Type I serum to a dilution of 1/200.

(3) One reacted with this serum to a dilution of 1/100.

(4) Eighty gave unequivocal results to a dilution of 1/400 with Type II serum and reacted with no other serum.

140 *Agglutination and Absorption of Agglutinin Reaction*

(5) Thirty-nine behaved similarly to a dilution of 1/200 of the same serum.

(6) One coccus reacted in presence of 1/100 dilution of Type II serum.

(7) Twenty cocci reacted specifically to Type III serum to a dilution of 1/400.

(8) Three reacted similarly, but to a dilution of 1/200.

(9) Sixteen cocci reacted specifically to Type IV serum up to a dilution of 1/400.

(10) Seven gave a specific reaction with this serum to a dilution of 1/200.

That is, 234 of the 348 cocci gave unequivocal type results.

In making this total of the number of cocci which react specifically, I have excluded two strains, No. 3 and No. 6, owing to their poor agglutination.

(11) Eight strains of the organism failed to react in any way with any of the four type sera. Two of these were forwarded to the laboratory not as cultures but as suspensions.

TABLE XI.

Formula of reaction	Type I serum			Type II serum			Type III serum			Type IV serum		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
<i>a</i>	+	+	+	—	—	—	—	—	—	—	—	—
<i>a</i> ₁	+	—	—	—	—	—	—	—	—	—	—	—
<i>a</i> ₂	+	—	—	—	—	—	—	—	—	—	—	—
<i>b</i>	—	—	—	+	+	+	—	—	—	—	—	—
<i>b</i> ₁	—	—	—	+	+	—	—	—	—	—	—	—
<i>b</i> ₂	—	—	—	+	—	—	—	—	—	—	—	—
<i>c</i>	—	—	—	—	—	—	+	+	+	—	—	—
<i>c</i> ₁	—	—	—	—	—	—	+	+	—	—	—	—
<i>c</i> ₂	—	—	—	—	—	—	+	—	—	—	—	—
<i>d</i>	—	—	—	—	—	—	—	—	—	+	+	+
<i>d</i> ₁	—	—	—	—	—	—	—	—	—	+	+	—
<i>d</i> ₂	—	—	—	—	—	—	—	—	—	+	—	—
X	—	—	—	—	—	—	—	—	—	—	—	—

Note.—Cultures reacting according to formulæ *a*₂, *b*₂, *c*₂, or *d*₂, have been classed as inagglutinable, as, without verifying such a finding by applying the absorption test, and thereby definitely placing such cocci, it would be inadvisable to regard them as conforming to any of the four recognized types.

Commenting on these results it is remarkable, when it is borne in mind that we are dealing with what are admittedly closely allied organisms, that so high a proportion is susceptible to classification by the test employed.

(b) *Results in which the Reactions are not absolutely Specific, but show a Group Relationship.*—(1) Examples of what may be called the I to III group type and the II to IV group type.

Most authorities on the meningococcus agree that there are two main types of organism included in the meningococcus group. By employing the absorption of agglutinin test, it has been shown that Type I of the French authorities includes a small sub-group which, tested by this method, fails to absorb all the antibodies from Type I serum.

This small group is designated Type III at the Central Laboratory and it will be seen from the results in the previous paragraph that a number of strains of this organism are differentiated by agglutination alone from the other types, including Type I, by means of a specific Type III serum.

In view of the relationship, we should expect that a number of organisms which react with Type I serum would also react to a greater or less degree with Type III serum.

In all, sixty-three specimens of the organisms under consideration react with both Type I and Type III serum. The following table indicates the degree of reaction obtained with these cocci.

TABLE XII.

Formula of reaction	Type I serum			Type II serum			Type III serum			Type IV serum		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
A	+	+	+	—	—	—	+	—	—	—	—	—
B	+	+	+	—	—	—	+	+	—	—	—	—
C	+	+	—	—	—	—	+	—	—	—	—	—
D	+	+	—	—	—	—	+	+	+	—	—	—
E	+	—	—	—	—	—	+	+	+	—	—	—
F	+	—	—	—	—	—	+	+	—	—	—	—
G	+	+	+	—	—	—	+	+	+	—	—	—

(1) Thirty-one cocci react in a manner corresponding to the formula designated A in the above diagram.

(2) Nineteen according to formula B.

(3) Three according to formula C.

These may be regarded in all probability as Type I cocci.

(4) Three react according to formula D.

(5) Two to formula E.

(6) One to formula F.

(7) Four to formula G.

These organisms were all proved on subsequent examination—even those reacting to formula G—by the absorption of agglutinin test to be identical with either Type I or Type III cocci.

As in the case of the I—III groups, a similar affinity is noted between groups II and IV; Type IV is not recognized by the French authors, and like Type III in its relation to group I, is regarded by some as merely a variant of II. Using the absorption of agglutinin test, Type IV can be clearly differentiated from Type II. The following table illustrates the

142 *Agglutination and Absorption of Agglutinin Reaction*

reaction obtained with specimens of cocci which show agglutination in presence of Type II and Type IV serum.

TABLE XIII.

Formula of reaction	Type I serum			Type II serum			Type III serum			Type IV serum		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
A	—	—	—	+	+	+	—	—	—	+	—	—
B	—	—	—	+	+	+	—	—	—	+	+	—
C	—	—	—	+	+	—	—	—	—	+	—	—
D	—	—	—	+	—	—	—	—	—	+	+	+
E	—	—	—	+	+	—	—	—	—	+	+	—
F	—	—	—	+	+	+	—	—	—	+	+	+

(1) Twelve cocci react according to formula B.

(2) Three according to formula C.

(3) Two react to formula C.

(4) Three react to formula D.

(5) One reacts to formula E.

(6) Seven react to formula F.

In all, then, 28 specimens give II—IV group reactions; 17 of these are presumably Type II cocci, 3 are presumably Type IV, and 8 are equivocal, reacting equally well with Type II and Type IV sera.

The total number of organisms giving I—III and II—IV group reactions is therefore 91.

There remain, therefore, 23 cocci which cannot be placed either as specifically type cocci or as cocci showing the common group relationship of I—III, or II—IV.

The table on p. 143 illustrates the reactions of these cocci with the four type sera.

Of these cocci, therefore—

(1) Nine react in such a manner that they may be regarded as probably Type I cocci.

(2) Five as probably Type II.

(3) Two as probably Type III.

(4) Three as probably Type IV.

(5) Four are equivocal in their reactions.

These cocci have also been submitted to the absorption test and the majority of them qualify definitely as belonging to Types I, II, III, or IV.

Summarizing the agglutination results, then, 346 of the 356 cocci react with one or more of the type sera of Gordon. Ten specimens did not agglutinate. Included in the ten which fail to react are two which were received as suspensions, and two which were ruled out owing to their reacting in presence of 1/100 dilution, and no higher dilution of serum.

Revising the results, one may say that only 8 out of 354 failed to give an agglutination, an experimental error of 2.2 per cent.

In order, further, to control the findings obtained by the agglutination test as applied to the investigation of spinal strains of the organism, it has now been the practice of the Central Laboratory for some time past to verify these by means of the absorption of agglutinin reaction. The details of the technique of this reaction I shall here not discuss as this is fully described in an article on "The Differentiation by Means of the Absorption of Agglutinin Test of the Types of Meningococci obtained from the Cerebrospinal Fluid of Cases during the Current Outbreak of Cerebrospinal Fever" (THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, July, 1917).

TABLE XIV.

Culture	Type I serum			Type II serum			Type III serum			Type IV serum		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
29	+	+	+	+	-	-	-	-	-	-	-	-
42	+	+	+	+	-	-	-	-	-	-	-	-
72	+	+	+	+	-	-	+	-	-	+	-	-
70	+	+	+	+	-	-	+	-	-	+	+	-
174	+	+	+	+	-	-	+	+	-	+	-	-
84	+	+	+	+	-	-	+	-	-	-	-	-
77	+	+	+	+	+	-	+	+	-	-	-	-
396	+	+	+	+	-	-	+	+	-	-	-	-
82	+	+	-	+	-	-	-	-	-	-	-	-
31	+	+	+	+	+	+	-	-	-	-	-	-
170	-	-	-	+	+	+	+	-	-	-	-	-
214	+	-	-	+	+	+	-	-	-	-	-	-
379	+	+	-	+	+	+	-	-	-	-	-	-
315	-	-	-	+	+	+	+	-	-	+	-	-
168	-	-	-	+	+	-	+	-	-	-	-	-
335	-	-	-	-	-	-	+	+	+	+	+	-
181	-	-	-	-	-	-	+	+	-	+	-	-
179	-	-	-	+	+	-	+	+	-	-	-	-
196	-	-	-	+	+	+	+	+	+	+	-	-
Ex. I	+	+	-	-	-	-	-	-	-	+	+	+
Ex. II	+	+	-	-	-	-	-	-	-	+	+	+
75	+	-	-	+	-	-	-	-	-	+	+	+
398	-	-	-	+	+	+	+	-	-	+	+	+

In this series of observations, 107 cocci were completely investigated, being tested each with all of the type sera. Of these 107 cocci, 101 qualified definitely as belonging to one or other of the types defined by Gordon; six could not be so placed, but of these three had died before the investigation was completed.

This inquiry brought to light an interesting point in respect of Type II. Absorption showed that the sera produced by certain cocci agglutinated all the representatives of the group, but were not necessarily absorbed by contact with all of these. Other strains gave sera which were less potent in that they did not agglutinate so many strains to the full dilution of 1/400. They did, however, agglutinate both the organism used for immunizing the animal and a number of other strains provisionally classed as Type II to the full titre, and they were absorbed by the majority of the members of the group.

144 *Agglutination and Absorption of Agglutinin Reaction*

Type II appears to include a complex sub-group and shows considerable variation among the cocci comprised therein. A Type II serum can be produced which is suitable for the agglutination test, in that all the members of the group are agglutinated by it, but such a serum is absorbed only by a limited number of specimens of Type II cocci.

The investigation, by the absorption test, of cocci provisionally classed as Type II is therefore a difficult procedure; and more than one serum must usually be absorbed before the organism can be definitely placed.

Ten strains provisionally classed as Type II cocci, and available for examination at one time, were used for absorbing three different Type II sera. The results obtained in the experiment are summarized in the following diagram:—

TABLE XV.

Coccus	H. serum	Ml. serum	D. serum
(xxvi) Ou.	—	+	+
(xxxi) Wy.	—	+	+
(v) D.	—	—	+
(xvi) F.	+	—	—
(iv) Ja.	—	+	+
(xxix) New.	+	+	+
(i) A.	+	+	P.
F/ Har.	+	+	P.
(xxviii) Eng.	—	+	+
(xxxii) Clen.	—	—	+

+ = Complete or marked saturation.

— = No saturation.

P. = Result equivocal.

One of the cocci absorbed all three sera—it would be suitable for the preparation of an agglutinating serum; seven absorbed two of the sera, and two absorbed only one.

If, in immunizing animals, a coccus is employed which produces a serum similar to that designated "H" in the above diagram, a serum is obtained which is suitable for the examination of Type II cocci by the agglutination test. This serum may, however, be unsuitable for the examination of these by the absorption test in that only a limited number of Type II cocci will remove from it all the agglutinins.

In testing cultures, especially those of nasopharyngeal origin, the least specific (i.e., most difficult to absorb) serum should be used in order that we may be assured that cultures are not being discarded because of an ultra-specificity of the serum employed.

For similar reasons, when we are doing absorption tests with cocci provisionally classed as Type II the reaction should always be performed in duplicate.

(a) With the most "specific" and

(b) With the least "specific" Type II sera available.

CONCLUSION.

The results reviewed in this section indicate that the organisms responsible for the current outbreak of cerebrospinal fever amongst the military forces are comprised, with remarkably few exceptions, in the four types of meningococcus defined by Gordon.

It might conceivably be contended, however, that the agglutination test does not serve to distinguish the meningococcus from other Gram-negative cocci that are not infrequently found in the nasopharynx, and which are so like that organism both in morphological characters and cultural reactions as to be indistinguishable from it thereby.

While engaged in studying the spinal strains of the organism by means of the absorption of agglutinin test, I took the opportunity of examining a number of specimens of Gram-negative cocci obtained from the nasopharynx, which had been regarded as meningococci because of their agglutination reactions. In respect of agglutination and absorption of agglutinin these cocci behaved as did the strains of spinal origin.

When examining the nasopharynx of a large number of men, there are not infrequently obtained cultures of organisms closely resembling the meningococcus which fail to react under standard conditions with any of the type sera. Are these meningococci or are they not?

The investigation of a consecutive series of forty such cocci has been completed and it was found that none of them absorbed the agglutinin from any of the four type sera. In examining these, the standard technique was used and each coccus was tested against five sera—Type I, Type III, Type IV and two specimens of Type II—to eliminate possible error due to the complexity of Type II.

Some of the pharyngeal cocci which fail to absorb the type sera may, when inoculated into animals, produce agglutinins which in high concentrations agglutinate certain strains of meningococci. This is especially liable to occur if the process of immunization be prolonged. It might, therefore, be suggested that such organisms could in course of time evolve into meningococci.

Up to the present, however, they have not been in our experience encountered invading the meninges with sufficient frequency during the current epidemic to justify their being regarded as pathogenic. It seems, I think, inadvisable—in the present state of our knowledge at least—to accept a hypothesis based on group agglutination, that the evolution of pathogenic from non-pathogenic organisms, if it occur at all, occurs sufficiently rapidly to invalidate the employment of serological methods in the identification of micro-organisms of known pathogenic significance.

Surely the most ardent evolutionary hypothesisist would not insist that the Old World apes must needs be endowed with the intellect and other attributes of man because the serum of those animals gives a positive reaction with anti-human precipitin?

RECOLLECTIONS OF AN ATTACK OF YELLOW FEVER..

By A PATIENT.

WHO is there who will not confess on due reflection to having wasted valuable opportunities and much time pursuing theories not founded on fact, instead of facing every new problem with an open mind?

It used to be customary to regard yellow fever as a disease strictly confined to the sea-coast. Even Sir Patrick Manson, in the 1908 volume of his "Tropical Diseases," after citing the exceptions to this rule, explains them away, saying: "In spreading inland it follows the lines of communication—railways, canals, navigable rivers."

Another common belief is that the *Stegomyia fasciata* is a strictly domestic mosquito. Yet there are specimens in the British Museum that were developed from eggs deposited in calabashes of water placed in wild bush remote from human habitations and inhabited only by baboons and various antelopes and birds, by hyænas and an occasional lion or two.

Carefully reared in these doctrines I landed in a remote bush station of the Northern Territories of the West Coast of Africa, situated far from Coomassie, the nearest railway station, and quite out of any line of communication such as would give facilities for the spread of yellow fever. In spite of my training, natural curiosity and perhaps scepticism made me suspect that yellow fever was a cause of certain deaths from obscure causes. But post-mortems were never allowed by the natives, and on the only occasion when I did insist on one the police stood to arms for my protection till I had finished. I suspected the occurrence of yellow fever in cattle too, but the case of Imoru Grunshi and another native policeman quite eluded my grasp till I went down myself. I well remember Imoru, I should know him again if I met him. He had low fever and no malaria parasites in his blood. He had headache too, and was very weak, but would not come into hospital, and kept on attending hospital daily, looking deadly ill. On the fifth day I missed him and being anxious, sent the dispenser down to see him. He said he was very bad and his urine was like pure blood, so I sent for a specimen. It arrived next day and was merely high-coloured urine, and Imoru brought it himself. My interpreter was not brilliant at any language, and that was all I could find out by his help. However, I saw Imoru's eyes were deep yellow and thought of yellow fever, but the patient was fairly well now, temperature normal and pulse a little quick, but he felt much better and finally the fetish of the hinterland's immunity dispelled the thought for a while.

Another such case arose, but it was not so striking as Imoru's. He got well too.

I made inquiries and found that the Germans recognized yellow fever

occurring up as far as San Salemango in Togoland, but I did not find out how they accounted for it.

I was the next to go down and was at last thoroughly convinced that the disease was endemic where I was stationed.

At the height of my own illness I recollected the case of Imoru Grunshi and mentioned it to the doctors who attended me and on recovery mentioned it to my successor, hoping to give him a clue to the proof that yellow fever was endemic in the district.

On September 6, 1913, the District Commissioner was relieved at Bole, Northern Territories, Gold Coast, by his successor. A large gathering of chiefs came to welcome back the relieving District Commissioner whom they adored. At night I went to dinner to meet the new arrival, and during the course of the dinner my interest suddenly flagged. Everything had lost its taste, and I felt queer. Asking the host's permission, I took my temperature and found it to be 101. I retired at once to bed, as a matter of precaution, as there was scarcely any reason but the temperature to excuse it.

I slept very well and next day was in exactly the same condition, and kept bed all day, feeling very drowsy, but quite satisfied with my condition. The District Commissioner going on leave called to say good-bye and settle some affairs, and I got up out of bed most unwillingly to get something for him. On returning I felt a stinging at the side of my left knee, and caught a tsetse-fly fastened on the spot. I recognized it easily as *Glossina tachinoides*, and remember being extremely annoyed at it. This was Sunday morning, and I spent the day and the next two in bed, thinking I had a low malaria. The temperature scarcely varied, and I had no discomfort, and by Wednesday morning I felt justified in getting up early, and going over to attend to patients. I had moreover many cultures of trypanosomes going on, and an interesting aecidiomycete, whose life history I was working out. There was also cattle disease, which I looked on as akin to yellow fever, and I did not want to miss any chance to dissect a dead animal.

These three days of fever were uneventful, and I was immensely surprised on finishing hospital duties that I had scarcely power to get back to my house. On getting back, however, I took out the microscope and was horrified to find I could not attend or take any interest in what I was doing. Luckily the new District Commissioner came over and distracted my attention, and I put away the microscope. On Thursday and Friday and the most of Saturday I made slight progress. No rise of temperature ever took place, but I noticed that I could get a rise to 103° F. easily by putting the thermometer in my mouth immediately after a meal. This rise was very transitory, and I regarded it as evidence that all was not well, as the greatest rise I ever could get in health in this way was 101° F., and even then I was not sure that there was not some malaria about me, as I was taking quinine very steadily.

On Saturday I managed my duties so well that I consented to go out for a long walk with the District Commissioner to the south of Bole. We reached old ruins which we discussed. Bole had been overrun by Samory not so very long ago, and it is still full of dead men's bones. We were speaking of these things and our own adventures when the sun began to set, and we saw it would take us all our time to get home by 6 p.m. We set out and got on a little way when I said to the District Commissioner, "I am in for rheumatic fever, and it is a mystery how that should be as I have not got a chill or wetting at all." I discussed the symptoms and said it can't be malaria at all. When we got within sight of my house I gathered my remaining strength and rushed for it, and on arriving shouted for the boy, who helped me to undress, and then I collapsed on the bed and was tucked in carefully by the boy. The District Commissioner came over in half an hour and took the temperature and prescribed quinine. The temperature was 102° F. The headache was simply appalling, and the pains in the stomach were indescribable. Bilious vomiting commenced, and I decided to have some more quinine and mist. alba. My skin was horribly dry, and I had grave suspicions that I had not malaria at all, but something incurable, so I took the quinine merely to keep the District Commissioner from worrying, and to prove that it was not malaria. I vomited incessantly, and between the attacks would tell my kind attendant the funniest stories I had ever heard, hoping to deceive him that I was not so bad as I felt, and to allay his fears. My mind was exquisitely alert, and no sleep came till about 3 a.m., when I was drowsy.

The 14th inst. was dull and uninteresting. The District Commissioner had his duties to attend to, and I could look after myself. At 6 p.m. I had reached 102° F., and at 8 p.m. 106° F. The District Commissioner then took a grave view of the case, and I was startled at 9 p.m. by the arrival of a dozen police with the District Commissioner's own bed. They lifted me out gently from my camp bed and put me in my deck chair, and the District Commissioner had the bedclothes transferred to the new bed. Meanwhile I announced that I had not malaria at all, but in all probability yellow fever. I got him to bring me a sealed tube with a solution of quinine in it, and my hypodermic case, and I injected a dose into my flank. The District Commissioner got very pale, turned away and I thought he would faint, so I said something to show that it was a trifling proceeding indeed, then explained the rationale of the proceeding to him. I said: "This will be my last dose of quinine, if it does not make a very appreciable improvement in my condition in a very short time." I explained that the vomiting might have prevented an effective dose reaching the blood, but the injection would obviate this difficulty, and if unsuccessful, would prove that the disease was not malaria at all. He agreed, and said he would treat me exactly as I desired. That night was spent in the most exquisite agony, and I remember remarking that it was the only time in my life I had been in a bad fix, and failed absolutely to see any humour in the situation. The

vomiting was so sudden and so urgent that I was thrown violently across the bed in my hurry to turn round and keep the bed clean. I remember also rating the District Commissioner very soundly indeed for his folly in sitting up, nursing me at his imminent peril, when my boys were eager and willing to do it and would run less risk. Later on, in the early morning, I opened my eyes and saw him dozing, and his whole face seemed to be black with mosquitoes. Nevertheless he refused to leave me, when the mere misery of the bites alone would have been sufficient justification for beating a retreat to bed.

The next morning when he came to see further what was to be done with me, I told him finally that I really had yellow fever, and would just have to put up with it. The very first thing I wished him to do was to send a telegram to the Governor of the Gold Coast, reporting that I had probably yellow fever, and to wait a full day and then wire again to say I certainly had it. "That," I said, "will ensure that my people at home get fair and speedy warning of the matter, and probably by to-morrow in any case I shall be past all interest in what happens, and won't be able to give you any more instructions." I next asked him to wire to Wa and to Kintampo for help, as he could not go on alone. I then asked him to bring my notes from Sir Patrick Manson's lectures, taken at the London School of Tropical Medicine, and with my own finger pointed out the words—"Treatment: Common sense and nursing. Hot fluid must be supplied as required but on no account must food be given. The patient won't die of starvation in five days." "Now," I said to the District Commissioner, "no food for me for five days, and, further, no medicine either. You can get a pill box of soda bicarbonate from Mr. Mõnsah, the dispenser, but don't let him send Sternberg's mixture, I would rather die a natural death than have perchloride poisoning added to my tortures. The boys can keep the sparklets going all the time, as I have bulbs to last a year, and they know how to manage the filter." I then pointed out the following words in my own handwriting, copied from Sir P. Manson's own dictation: "Mortality varies. Thirty per cent is the average. Fifty per cent to ninety per cent is an epidemic, or as low as ten per cent. A drunkard never recovers. A temperate liver usually recovers. If thermometer does not rise over 103° F. recovery is invariable. Above 106° F. all die." "Now," I said, "don't worry; you see I don't drink at all, and I have not reached 106° F. yet." I did not know he had told me a lie the night before, and wondered at his silence, and did not know I was to reach 106° F. in less than twenty-four hours.

This was a very busy day for me, vomiting being apparently incessant, but I had time to notice that everything I saw in broad daylight was brilliant yellow, and was very glad I had diagnosed the case even before getting so broad a hint as that. I was highly alert also, and called my steward boy and rebuked him for allowing a hole to wear in the mud floor, and had it filled up at once. That day was really too awful to bear any

description at all, but I still tried to pretend I was fairly well, for the other white man's sake, who was doing his best to help me. About 8 p.m. I was so hopelessly spent that I called him and gave him instructions how to make normal saline, and asked him to prepare three pints, as I intended to have a rectal infusion, slowly, to try to make up for the loss of water from my blood caused by the constant vomiting. I see the good fellow has noted that it took effect in a few minutes. Well, so it did, but I was never nearer death than then. I had administered it much too fast, and when I got back into bed I seriously wondered if I would ever be able to turn on my back again, or would just die on my face. However, I pulled through so fast that I slipped out of bed again the same night and arranged all my correspondence, so that there would be no trouble left for other people who had to look for things.

That night was really the worst I passed. I had been making a new medium from fresh blood serum, and had a good many cultures of trypanosomes going on. The Petri dishes I used were claret glasses covered with champagne glasses. They made delightful media dishes, and I used them for little else. The tornadoes were in full swing just then, and every night one tore through the house from end to end, carrying away papers and books and smashing things I prized highly. And yet people often forget that when they have made only a casual visit of inspection to the coast in the dry season. Rain poured nightly through the roof into my eyes, and added to my indignation. I called the boys, and indeed, as a rule, did not need to call them, they were there on the very first distant moaning of the wind, and covered up my bed with a ground sheet, and so mostly saved me from the dripping through the roof, which worried me much more than the fever. The fever had to be put up with, while the dripping was a thing that could be dealt with. Well, these champagne glasses went the way of all the world at that time, and the crash was terrible.

Then I dreamt strange things, but, realizing their folly, resolved to keep quiet. Then a calm came, a fairly long pause, and I was happy and comfortable. I opened my eyes. It was dawn. My attendant was sitting over me with a bath sponge dripping with cold water. When he saw I was awake he said: "It's all right," and disappeared like a shot. I did not dare to move or sit up. I knew acutely what had happened. I had in fact not dared to sit up for some time before, fearing instant death. But I looked around and felt my arms and legs tugging violently. I was horrified; I was in convulsions. I shouted, "Come quickly. Look at my legs. I'm about done. I can't stop these twitchings, and if they don't pass off in half an hour I will just have to die. Get my keys from below my pillow, and show them to me." He did so, and I showed him the key of the box I wanted opened. He opened it and got a box of hypodermic tabloids. I said, "I am quite clear now. I know I was delirious last night, but I am not now. This is my last chance probably, but if I pull

through the next half hour I will get better, but it will take some time, and you must not give me any food until I ask it. You will find a tube of morphine hydrochloride tabloids in that box. Each is $\frac{1}{4}$ grain. If you break one into two and give me one half that will be $\frac{1}{2}$ grain. You see I understand perfectly what I am talking about. If the morphine acts, good and well; if not, you can't be blamed." He did as I asked him. In fifteen minutes I felt easier, and in half an hour felt sure of recovery. Nothing seemed so plain to me all my life as the action of this morphine, and everything that had happened to me in the last few hours.

In spite of my strict injunctions I see it in the official report that I was persuaded to take Benger's food twice that very day, but it soon was rejected, and did more harm than good. Another futile attempt to palm off tea upon me was made late that night, with the same result, but still I felt sure of recovery, and I do not blame my anxious attendant for his endeavour to get me to retain something.

The next two days were dull and uninteresting. Vomiting was so frequent that the resolution not to take food was not defeated. A medical officer arrived on the second of these days, September 18. He had gallantly ridden seventy miles at a stretch through swamps and tornadoes. His transport had been effected by hammock, and by my own and the District Commissioner's horses. All these unhappy animals have sleeping sickness, and ours were no exception, only mine was not so bad as the other at that time. Well, the other got washed from under the Medical Officer's feet into a torrent, and got stuffed under a bridge. The Medical Officer just managed by superhuman efforts to push it out "with a stick," as he said, and save its life, while he himself stood waist deep on the bridge, to his own great risk. He got in anyhow, and was amazed to find my rapid improvement and ability to take interest in his adventures. I had once made an all night record ride, going fifty miles on one horse through the most romantic country I ever set eyes upon, in the most brilliant moonlight that ever seemed to have shone, and no wonder I was interested. He had beaten that record.

Next day I was sentenced to champagne and Valentine's beef juice. I did not like either. My urine was exactly like the beef juice, and I shivered to see it, and wondered if I would die in that doleful place, or go home with chronic nephritis:

The morning of the 20th opened bright and cheerily. I was as happy as could be. It was Sunday, a totally different day to all others, even although I did the same work as a rule. I wondered if the news had been cabled home. It was worse than all that had gone before, and I thought if I only had had patience nobody need ever have known what I had been through. I wrote home that day but was defeated in a line or two. Only I clearly remember saying, notwithstanding the horror of the previous day, that I would recover without any complications.

The 21st passed quietly by, and a second doctor arrived next day.

That selfsame day my boy Abu the Grunshi came to me much agitated. He was a young savage I had picked up the year before and taught to speak English. This Abu was an apt scholar and also learned to bake bread, to preserve the race of yeast I had raised, and to starch and iron collars and tablecloths. He preferred this life to the up country life of the Kassassie savages among whom I found him. Abu had been out visiting the soldiers. His father was a soldier, and he was welcome among them. He said, "Massah, no black man be fit to live all them nine days and take no chop. Black man be die one time, he go die in three days. White man be be different, different, chop it no trouble him too much. Black man be die when all him belly be empty, nothing live for inside, he no fit to live when him belly trouble him too much. He die too fast."

Next day Abu came in and said, "Massah, all de mammies that live for sojah lines, they go cry to-day and tear out all de hair from them heads. They go cry too much so God hear, and it vex him too much and he go make you better quick." Asked why they did that he said I had cured the serjeant's "mammy" of bad sickness, she go die too soon, and I had put medicine in her arm, and she had got better next day. I remembered then giving her emetine hydrobromide for dysentery and it had really cured her. She then ordered out the "mammies" to hold this day of supplication, and I had to send them a kind message of thanks.

Next day I had time to examine myself more carefully, and noted that my fingers had been bleeding beneath the nails and were all black in consequence, and my skin was guinea gold.

At that time the chiefs of the district began to make very insistent demands to see me. I had lived nine days without food and was getting well, and they could not bear the suspense any longer. I was much worried in this way, and put them off and off. They behaved with the utmost good taste. Never the sound of a drum was heard from the day I lay down till the day I officially received them in great formality. Meantime I carried on well. The doctors came daily to see me. They played golf in the afternoon, and I waited on for recovery, having an occasional moment of anxiety when my stomach was rebellious. I drank vast quantities of cold soda water, going right in the face of Sir Patrick Manson's warm drink regime. My Osler and Macrae was consulted and it was found good to give calf-foot jelly and iced champagne. We had none of these dainties. I fed on tinned "Ideal" milk and sparklet water and managed to live on it. It is absolutely amazing to think what pitiful stuff will support human life that is determined not to be put out. We had no mystifying diet sheets up at Bole. We had medical comforts so-called, and I have said what I thought of them already. "Ideal" milk was good enough and variety enough for me. It may have worried subsequent investigators at Bole to find no diet sheets, but they don't cure people. There was certainly a long-winded medical history left, for I typed it myself from the notes of the doctors who saw me, in quadruplicate, leaving

a copy at Bole, and that before I was able to hold a pen long enough to write an ordinary letter. Well, that was after I got up, of course.

It was on the first of October that I got up. When the chiefs heard of it, they could no longer control themselves, but came to the District Commissioner and said he must tell them definitely when I could receive them. I fixed it for two days later, on Saturday.

On Saturday then I was up betimes, for an invalid. I felt there was something in the air, and sent my steward down to buy a large quantity of kola nuts. When I got into my deck chair on the verandah, I heard drilling on the parade ground, and shortly the police marched up in full dress, headed by the serjeant, who formed them up in two ranks in front of the verandah and stepped in front and made an address. I replied with gratitude, and sent them a present of kola nuts. They then marched off, and the chiefs of the district arrived, headed by the Chief of Bole supported by his interpreter. He addressed me thus. "God has been very good to you in saving your life. We know you love our town, and you have been good to us and worked hard to save the sick, and now you want to build us a new town. We have seen that you were right, for the rains have broken many old houses, and we need good ones. We hope you will come back to us and make everything right, and we thank God for having saved you now." He then stepped forward, bowed low and shook hands, and they all did so in turn. I made a reply and thanked them for all their kindness, and sent them a present. Then the real business of the day began. Native sports were held on the parade ground. Races, high jumping, tug-of-war, horse races, etc., till noon. The District Commissioner and the doctors were the leading spirits, and the natives went heart and soul into the fun. At night a grand native dance was held, and the tom-toms made a deafening din.

That afternoon, by the way, the serjeant's wife called, carrying a present of yams, and a fowl, and some eggs. She was gaily rigged out in her very finest purple velvet cloth. It must have cost a good deal in that country. It suited her admirably. She thanked me for having saved her life not long before, and felt sure that it had some connexion with my own recovery. I thanked her and sent her a present of kola nuts.

The ten days of my convalescence, from September 20 to the day I got up, were extremely happy. The other white men came at least twice a day to see me, and were very merry. But I had a few night terrors. A brain so excessively active as mine had been, exercised with superintending my own treatment, trying to look after my nurse and save him from going down next, and managing the boys, could not fail to be tired.

The house had to be cleaned as rigorously as if I was well, but I neglected my poor horse. It used to run loose as a dog, and when I was well came every afternoon at tea-time to have a lump of loaf sugar from my hand, and then it went away satisfied. The District Commissioner had been on the outlook, however, and he ordered my horse boy to sleep

near the horse, so that no harm could come to it. They say lions used to prowl about, but I never saw one or heard anything but the dismal howls of hyænas. One day, or rather night, the District Commissioner slipped round to the stable and found the horse boy missing. He sent out police and brought him back, and had him up in court next morning. The boy said he had only been away a moment, but when asked why his clothes were also missing, he said if he left them a moment the horse would eat them up. This produced great consternation in court. The natives were sure the boy was lying, but the Commissioner took a philosophic view of the case, and said if the boy could get any horse at all to eat up clothes he would let him off, otherwise he must suffer "one dozen of the very best with the cat." The boy was nothing daunted, and men went out and brought in horses, and one by one they smelt the boy's clothes, only to look disgusted and go away. Then my little horse came up and directly the clothes were presented to it, it proceeded to rend them in pieces. The boy was acquitted.

Well, about these night terrors. No sooner had I closed my eyes to compose myself for the night's sleep, for the days were unclouded, then visitors arrived. Six other selves, all of them me, sat at my right shoulder on the pillow and worried me with their disputes. They disappeared whenever I ordered them or tried to open my eyes. Then I would sometimes waken up and find my feet bare and wonder what right they had to be in the bed at all. They were quite useless, and it took me a few seconds to see the funniness of the idea. No doubt this was just at the time when the kidneys were most severely taxed, for it was quite a late symptom. Another night all the chiefs of the district sat round my bed and talked incessantly. Then, next night, a crowd of old villainous white men, gold diggers, got round me and plotted my death, which did not worry me in the least degree.

It was about the third of October when I had ventured across to hospital to see everything doing, that a boy came and met us and asked us for "them small bottle you put under man's tongue to see if he be sick." We gave him a thermometer, and had visions of yellow fever. Next day I was much weaker. My heart was distinctly bad, but I distilled water to make Giemsa's stain, as we were anxious about the new case. I crept along the house wall for support, but the job had to be done, and it was done. We saw nothing in the stained blood specimen, but the case was typical yellow fever.

When the second invalid had recovered he and the other doctor who had come from the north, and myself, all set out for home. Passing the police lines the whole detachment was found drawn up with the District Commissioner at its head, and I, as senior, dismounted from my hammock and received an address from the serjeant. I inspected the detachment who were in full dress, and replied, then got on the move again, and the force followed in fours. Coming through the town we saw all the

little rolling hillocks that characterize Bole covered with wild savages, armed with formidable Dane guns. They had them rammed with powder, and when we passed crossed them over our heads and let off volley after volley, then rushed on and fired again. Their yells were terrible, and would have been terrifying if we had not known that they were meant for the greatest sign of friendship.

After a mile's hammocking we reached the top of a long hill, whereon were seen the Chief of Bole, his interpreter, "Sir Galahad," the police, and the District Commissioner. A final farewell was said and an affecting scene was witnessed.

After a few days we reached the great river Volta, and then crossed into the forest of Ashanti. We had happy days travelling in the forest despite our weakness, and we never once did less than a full day's journey. We had revolver or rifle practice in the afternoon, and at night our dinner table was illuminated with a bush-made acetylene lamp, constructed out of a jam tin, a coffee tin, and a flour tin, all telescoped into each other in such a way that the coffee tin floated in the flour one and raised the jam tin with its cargo of calcium carbide out of the water whenever enough acetylene was generated to supply the light. Such crowds of insects gathered about that light.

Arrived at Coomassie, we were solemnly condemned to hospital. We squirmed under it at first, but they were very good to us and gave us far too much food. There was a capital little dog in the place whom we stuffed with our excess food every meal till the grievance was abated.

Convalescence in yellow fever is a most rapid process, and I sometimes regret not having been allowed to finish out the twelve months on the coast. We stayed at Coomassie about a week and then left for Secondee, where we were again solemnly committed to hospital. At Secondee we were well treated as usual, and in a few days we were on board the ship, homeward bound.

For sheer agony yellow fever must take first rank. It surpasses rheumatic fever in the exquisiteness of the pains, their variety, and incurability. It is sheer madness to give drugs to relieve them. Any drug able to do it would have to be given in an almost fatal dose. In cerebrospinal fever stupor sets in, and although the patient goes raving on, he ceases to feel as acutely. Not so in yellow fever, he keeps alert till nearly the end. There is a limit to the power to feel pain, and whether it is caused by heated irons, or jagged knives, or disease, it ceases to increase beyond that. The sense organs then become exhausted and actually feel less than is going on, but it takes about six days for that to happen. In yellow fever, aspirin, sodium salicylate, and phenacetin never reach the blood or the seat of pain or the brain. They are not absorbed at all. They are not even vomited out, they are shot out with explosive force, and there is danger of rupturing the blood-vessels of the brain with the violence of the action.

It is cruel to force drugs in through the skin, in the delusion that they may do good. Quinine is useless, and if the blood has been proved free of malaria parasites, how on earth can the subsequent giving of quinine be justified? Pilocarpine is worse than useless, as the blood is already too dense, and if the fetish of a moist skin is needful then water must be supplied by rectum. Indeed it is a wise thing to do. It would flush out the kidneys, and reduce toxæmia, and make up for water lost in vomiting. No water is absorbed by the stomach, but it should be drunk constantly to clean out the blood and acid in the stomach, otherwise there will be dry retching, which will soon kill the patient. It is good to put sodium bicarbonate in the water and to have it aerated to make it more pleasant, and the alkalinity neutralizes the excessive acidity of the stomach secretion.

The headache is intractable by any safe dose of any drug. Cold water cloths help it distinctly.

The abdominal pains are peritoneal, and mustard at least distracts one's attention from them. There is a lot of tympanites, and a turpentine and soap enema would be good, and would pave the way for a saline infusion. After one good evacuation of the bowels there is no need whatever to worry for another for about nine days, in a bad case, for no food has been taken, and there is no difficulty in starting the bowels with absolute regularity as soon as food is resumed.

When hyperpyrexia sets in, cold sponging is excellent. If the pathology of yellow fever were constantly borne in mind, the futility of drugging would be realized, and many more recoveries than at present would take place. Saline, soda, sponging and starvation will increase the recovery rate immensely, and to these I attribute my recovery. For stronger men than I, with a better record of coast sickness, have gone down with yellow fever who might have made a better fight if they had not persecuted their attendant to relieve their agony by some drug or other, and we all know how hard it is to refuse.

It would be a good thing if every white man going to the Coast were taught in the plainest language that yellow fever is endemic, the hour of infection being probably between 6 and 7.30 p.m., when men sit out in the open and get bitten most. They should be taught that it is almost certainly fatal, and that any chance they have is in their own hands. They need expect nothing to relieve their pains or shorten their disease in the way of drugs, but they will make things very much easier if they will lie still and drink only water, and never worry about food for days on end.

The Sequelæ.—There are no regrets left, no bitterness. Recovery was well worth the fight. The hair fell out for a time, the nails got black and cracked and became permanently thin. There were patches of anæsthesia and hyperæsthesia all over, which lasted about two weeks. It may have helped to save me that I attempted to be cheerful, but what certainly did save me was the District Commissioner's help, for which I shall ever be grateful.

SOME STRAINS OF ORGANISMS FOUND IN DYSENTERY SUSPECT CASES IN FRANCE, SHOWING PECULIAR AGGLUTINATING PHENOMENA AND SUGAR REACTIONS.

BY CAPTAIN F. N. B. SMARTT.

Royal Army Medical Corps.

THE observations here recorded are the result of some months' work at a Base in France.

I am indebted to Captain Lazarus Barlow, Pathologist, No. — General Hospital, for the material for the first seven cases; these occurred while I was acting for Captain Sladden, Pathologist, No. — Stationary Hospital.

Later, while acting Pathologist at No. — Stationary Hospital, observations were continued on this material and extended on 120 dysentery suspect fæces received from Captain Sladden. It is not proposed to discuss here in detail the bacteriology of dysentery as laid down in text books on the subject. The types of organisms there described are well known to those who have worked on this disease, and one or more of the types are found in most parts of the world.

These types are all fairly clear cut, the basis of their classification is dependent on sugar reactions and sub-groups are distinguished by their behaviour towards specific agglutinating sera.

The bacteriological diagnosis depends firstly on certain sugar reactions, and secondly on the specificity of the agglutination phenomenon. It is a bacteriological axiom that no dysentery organism ferments lactose nor forms gas in any carbohydrate, and also that the agglutination phenomenon is a strictly specific one—excepting only some interchange of group agglutination such as may occur between members of the enteric group or members of the dysentery group with the specific sera of the respective group.

In isolating dysentery organisms it is usual to give first importance to the fact that these organisms do not ferment lactose, and a medium containing this carbohydrate, such as MacConkey's, is used for plating the fæces. On this medium the dysentery organisms grow as colourless colonies and can be picked out from the common intestinal growths of the *Bacillus coli* group which grow red.

Colourless colonies may be tested at once for agglutination, or later after further sugar tests. Where large numbers of dysentery suspect cases have to be dealt with, a rapid method of diagnosis has of necessity to be adopted, and likely colonies may under these circumstances be tested at once for agglutination; later, if time permits, the more complete evidence of sugar differentiation may be sought with those colonies that show specific agglutination.

In this report are described all organisms that I have succeeded in isolating from a number of dysentery suspect cases, and which give agglutination with specific dysentery sera. In neither their sugar reactions nor

158 *Some Strains of Organisms found in Dysentery Cases*

specific agglutinating properties can the majority of these organisms be classed as text-book types. All show the common and characteristic feature of agglutination with specific dysentery sera, but in nearly every case the diagnostic specificity of this phenomenon is confused and complicated by the fact that they also agglutinate with one or more of the enteric group specific sera. For the sake of clearness and brevity this may be called the phenomenon of "multiple" agglutination.

Eighteen cases are reported in all. They can be differentiated on sugar reactions into seven types; one of these types claims seven of the total cases, and falls into the Flexner-Y group as far as can be ascertained with the available carbohydrates. The remaining six types show sugar reactions quite dissimilar to any known dysentery group.

The organisms were all recovered from dysentery suspect cases, that is, cases which had come down the line suffering from diarrhoea with blood and mucus, or with a recent history of such diarrhoea.

It is to be noted that at the time of examination the stools were in the great majority of cases "normal," that is to say, contained neither blood nor mucus macroscopically and microscopically, nor did the stools contain entamoeba.

The fact that the majority—eighty per cent approximately—of these cases were at the time of examination passing normal motions is of interest, because it is a stated fact in most text-books that classical *B. dysenteriae* is only usually recoverable during the early stages of the disease, and ceases to be found when the stools become normal.

These cases are shown in the various tables of this paper, and with the strains of organisms from them, are numbered 1 to 18.

The cases are divided into two series; the first seven belong to Series I, the remaining cases to Series II.

The first series occurred in routine examination over a period of one week, during which time 143 stools were examined. From these only typical non-lactose fermenting colonies which showed agglutination were worked on; these colonies were picked out as they occurred and put through different tests.

In the second series 120 stools were examined, and efforts were made to isolate agglutinating strains whether occurring as discrete colourless colonies in pure culture or mixed from various parts of the plate. In this series use was made of the observation made by Captain Sladden some time previously, viz., that lactose fermenting strains frequently agglutinated with dysentery specific sera. Agglutinating strains were, therefore, sought for both in lactose and non-lactose fermenting colonies and growths.

TECHNICAL ROUTINE.

The same procedure has been adopted throughout. The faeces are emulsified in saline and spread with a small loop on MacConkey plates in a series of strokes. The following day growth is tested for agglutination with

specific sera diluted 1 in 300. Discrete colourless colonies are tested separately when present; where no such colonies are evident, growth from three different parts of the plate are emulsified and tested separately. The dilutions are made on microscopic slides by mixing one loopful of emulsion with one loopful of specific serum diluted 1 in 150. The slides are put aside in a moist chamber at room temperature and microscopically examined for agglutination at the end of three or four hours.

Discrete colonies which show agglutination are subcultured direct through the sugars or replated in doubtful cases. Mixed growth showing agglutination are replated from growth itself, from the emulsion, or from both.

In the first series of cases it was found during routine examination of the plate growths that certain non-lactose fermenting colonies which agglutinated with specific dysentery sera also agglutinated with one or more of the specific enteric group sera in routine dilution (1 in 300).

When this was first observed it was thought that "mixed" growths were being met with, and that the cases were examples of mixed dysentery and enteric group infections. Careful isolation of these organisms, subsequent repeated agglutination tests, and the occurrence of this phenomenon again and again in other cases has proved that this is a distinct phenomenon and is not due to mixed growths.

When these agglutination tests are carried beyond routine 1 in 300 dilutions, it is found that in nearly every case the end point with Flexner-Y serum is much higher than with other sera. If the cultures are tested from day to day it will be found that while agglutination with dysentery sera remains constant, agglutination for other sera soon falls below 1 in 300, but does not entirely disappear. Subculturing in ordinary media does not seem to revive this diminished agglutinability to any appreciable extent in cultures a week or two old. When first isolated, heating at 60° C. does not affect the agglutinability of these strains.

Table I shows the agglutination properties of these strains (*a*) when first isolated, (*b*) on first subculture, and (*c*) in culture five to ten days old.

Fresh dilutions of stock sera were made from time to time to check previous results and obviate the fallacy of deterioration of the stock dilutions.

In Series II, 120 faeces were examined. Of these cases, twenty-seven were returned as positive Flexner-Y on routine agglutination of plate growths, with specific Flexner-Y serum.

Efforts were made to isolate these agglutinable strains in every case by subculture and succeeded in the eleven cases tabulated—40·7 per cent (Nos. 8 to 18).

In the unsuccessful cases no agglutinating colonies or growths could be detected in the subculture plates.

In Table II are given the sugar reactions of all strains.

Table III shows the number of types and the number of strains which can be placed in each on sugar reactions.

Neglecting the acid in dulcitol formed by the first three strains it is

TABLE I.

Strain	Agglutinations, 1/300 dilutions specific sera (a) When first isolated						Agglutinations, end-points. (b) First subculture				Agglutinations, end-points. Dilutions, 1/300 up (c) Five to ten days old culture				
	Shiga	Flexner-Y	Typhoid	Para A	Para B	Gaertner	Shiga	Flexner-Y	Typhoid	Para A	Para B	Typhoid	Flexner-Y	Shiga	Gaertner
1	+	+	+	+	+	+	+	1/600	—	1/300	—	—	1/600	—	—
2	+	+	+	+	+	+	—	1/1200	—	1/300	—	—	1/1200	—	—
3	+	+	+	+	+	+	—	1/1200	—	1/300	—	—	1/1200	—	—
4	+	+	+	+	+	+	1/600	1/1200	—	1/600	—	—	1/1200	Tr	—
5	+	+	+	+	+	+	—	1/300	—	—	—	—	1/300	—	—
6	+	+	+	+	+	+	Tr	1/600	Tr	Tr	Tr	—	1/600	—	—
7	+	+	+	+	+	+	1/300	1/1200	—	—	—	—	1/1800	—	—
8	+	+	+	+	+	+	—	1/1200	—	—	—	—	1/1200	—	—
9	+	+	+	+	+	+	—	1/600	1/600	—	—	—	1/600	—	—
10	+	+	+	+	+	+	—	1/600	1/300	1/300	—	—	1/600	—	—
11	+	+	+	+	+	+	—	1/1200	1/300	1/300	—	—	1/600	—	—
12	+	+	+	+	+	+	—	1/1200	1/300	1/300	1/300	—	1/600	—	—
13	+	+	+	+	+	+	—	1/1200	1/300	1/300	—	—	1/600	—	—
14	+	+	+	+	+	+	—	1/1200	1/300	1/300	1/300	—	1/1200	—	—
15	+	+	+	+	+	+	—	1/300	1/1200	1/1200	1/300	1/300	Tr	—	—
16	+	+	+	+	+	+	Tr	1/600	1/1200	1/600	1/600	1/600	1/600	Tr	—
17	+	+	+	+	+	+	Tr	1/1200	1/600	1/300	1/300	1/600	Tr	—	—
18	+	+	+	+	+	+	Tr	1/1200	1/300	1/300	1/300	—	1/600	Tr	—

* Not tested.

Tr Trace.

++ Complete agglutination.

+ Incomplete agglutination.

— No agglutination.

seen that these three strains, together with Nos. 10, 11, 12 and 17, for which no dulcitol was available, form a group of seven which fall into the Flexner-Y group.

Five of these strains show the phenomenon of multiple agglutination. These are the only strains in the whole series which in any way conform to the recognized types of *B. dysenteriae*.

TABLE II.

Strain	Motility	Gram stain	Gelatine	Litmus milk			Lactose	Mannite	Glucose	Saccharose	Dulcitol
				1st day	2nd day	3rd day					
1	—	—	—	SLA	ALK	ALK	O	A	A	O	SLA
2	—	—	—	SLA	ALK	ALK	O	A	A	O	SLA
3	—	—	—	SLA	ALK	ALK	O	A	A	O	SLA
4	—	—	—	*	*	*	O	O	A	A	SLA
5	—	—	—	*	*	*	O	O	A	A	SLA
6	—	—	—	SLA	ALK	ALK	O	AG	AG	O	SLA
7	—	—	—	SLA	ALK	ALK	O	O	A	A	SLA
8	—	—	—	A	SLA	ALK	O	O	A	A	*
9	—	—	—	A	SLA	ALK	O	AG	AG	O	*
10	—	—	—	SLA	ALK	ALK	O	A	A	O	*
11	—	—	—	SLA	ALK	ALK	O	A	A	O	*
12	—	—	—	SLA	ALK	ALK	O	A	A	O	*
13	—	—	—	A	A	A	A	A	A	O	*
14	—	—	—	A	AC	AC	A	A	A	A	*
15	—	—	—	A	A	A	AG	AG	AG	O	*
16	—	—	—	A	A	A	AG	AG	AG	O	*
17	—	—	—	A	ALK	ALK	O	A	A	O	*
18	—	—	—	A	A	A	AG	AG	AG	SLA	*

* Not tested.

TABLE III.

Types	Lactose	Mannite	Glucose	Saccharose	Type	Number of strains in each type
1	O	A	A	O	Flexner-Y ..	7
2	O	O	A	A	Aberrant ..	4
3	O	AG	AG	O	" ..	2
4	A	A	A	O	Atypical ..	1
5	A	A	A	A	" ..	1
6	AG	AG	AG	O	" ..	2
7	AG	AG	AG	SLA	" ..	1
Total ..	..	..	..	..	.. ..	18

This means that out of 143 cases in the first series—of which thirty-one were returned as positive on the assumed specificity of the agglutination phenomenon—only three of the seven non-lactose fermenting strains isolated are typical *B. dysenteriae*.

162 *Some Strains of Organisms found in Dysentery Cases*

Also, in the second series where twenty-seven cases out of 120 were returned as positive on agglutination, only six strains out of the eleven isolated are non-lactose fermenting and of these only four are typical *B. dysenteriae*.

It is to be noted that the phenomenon of multiple agglutination is common to the strains which conform in their sugar reactions to typical types and also to the strains which do not so conform.

It has been attempted to try and arrive at some proof as to the specificity of these organisms. The chief difficulties have been lack of time due to pressure of routine work and also the fact that complete serological tests could not be done because patients were evacuated immediately following diagnosis. Also these observations are so contrary to the usual conceptions of the bacteriology of dysentery that no systematic scheme of research had been devised to meet such a situation at the time when these cases were occurring.

Parallel agglutination tests were made with sera from the patients from whom the strains in Series I were isolated.

The end-points of agglutination are shown in Table IV,

TABLE IV.—MICROSCOPIC READING AFTER THREE HOURS ROOM TEMPERATURE.

Serum	Strains							Type
	1	2	3	4	5	6	7	
1	1/40	1/60	1/160	1/160	1/80	1/160	>1/160	Flexner-Y
2	1/40	1/40	1/40	1/160	1/80	>1/160	1/80	"
3	1/40	1/80	1/80	1/160	1/60	>1/160	1/160	"
4	1/80	1/80	1/160	>1/160	1/160	>1/160	>1/160	Aberrant
5	1/40	1/40	1/60	1/180	1/40	>1/160	1/160	"
6	—	Serum of this case not taken					—	"
7	1/80	1/80	1/60	1/160	1/80	>1/160	>1/160	"

No data are available as to the date of illness; such information would be of interest as affecting the titre and for comparative scrutiny of the table.

These figures at first sight seem to be of importance and to go a considerable way to support the assumption that these strains are specific, and not only specific but of a correlated type. But all the strains show enteric group agglutinability and the following table shows the agglutinins in the sera. The agglutinations may therefore be due to several factors.

The same sera with which tests in Table IV were made were put up according to Dreyer's method, using his "standard" emulsions.

The readings are given in Table V (A).

I do not consider this single reading of much importance, but the table is included as emphasizing the complexity of the whole position.

The figures are very conflicting, but it is to be remembered that one is dealing with many factors.

The agglutinins in the serum of an inoculated individual suffering from dysentery, and possibly enteric group infection, and from whom an organism has been isolated showing multiple agglutinability, may conceivably give rise to confusion in serological tests.

TABLE V (A).

No.	Date of inoculation	T	A	B	Shiga	Flexner	Y
1	TV/2, January 31, 1916 ; TAB, August 10, 1916	2,500	1,250	500	Not tested	50	250
2	TAB, May, 1916	1,250	1,250	250	" "	50	250
3	TAB, (?), 1916	2,500	1,250	250	" "	50	250
4	TAB, April, 1916	1,250	> 125	> 250	250 "	250	> 250
5	TV/2, December 21, 1915	1,250	125	80	40	40	> 250
6	Not known .. ..	..	Not* tested.				
7	TV/, August, 1915.. ..	1,250	—	—	—	25	—

Table V (B) shows the agglutinations given by sera from some cases in Series II by Dreyer's method.

TABLE V (B).

No.	T	A	B	Shiga	Flexner	Y
9	*	*	*	—	—	—
10	*	*	*	—	1/250	—
12	*	*	*	1/25	1/40	1/125
15	1/1,250	< 1/25	< 1/25	—	—	—
16	1/40	1/50	1/250	—	—	—

* Not tested.

FIXATION OF THE COMPLEMENT TESTS.

It was found impossible to carry out complete serological tests with the patient's sera because patients were evacuated early.

The various strains were preserved and were used in complement fixation tests with various sera as detailed later. In these tests the original method was followed, i.e., the complement in the sera to be tested was destroyed and guinea-pig's serum containing a known amount of complement used.

In carrying out these tests it is necessary to heat the bacillary emulsion to 60° C. to destroy any possible hæmolysins; also, where using sera which have stood for some days, it is advisable to test such sera for auto-fixation of the complement before proceeding to the general test.

Neglect of these precautions has resulted in discarding some sixty tests; in one batch this was seemingly due to the presence in the antigen emulsion of a hæmolysin as shown by hæmolysis in the antigen control tubes. In another batch of test a therapeutic antidyenteric serum showed

164 *Some Strains of Organisms found in Dysentery Cases*

auto-fixation of the complement ; the same thing occurred with some of the patient's sera which had been in the laboratory for some days. All these tests had to be discarded. The rationale of these tests is the converse of the true Wassermann in which a known antigen is used in conjunction with an unknown serum.

In these tests the antigen—emulsions of unknown organisms—is unknown and is used in conjunction with known sera. The sera used were (a) antidysenteric (therapeutic), (b) sera from dysentery patients, (c) sera from enteric group patients, (d) serum from an individual who had not had enteric or dysentery and had not received typhoid inoculation.

TABLE VI.

Serum	Inoculations	Case	Dreyer's Method. Agglutination End-points						Remarks
			S	F	Y	T	A	B	
A	..	..	1/500	<1/250	1/1250	—	—	—	Polyvalent anti-dysenteric therapeutic serum
B	TV/2, 1915	Para B	•	•	•	1/2500	1/40	1/800	
C	TV/2, 1915	Para B	•	•	•	1/500	<8	1/50	
D	TAB, 6/16	Para B	•	•	•	1/400	1/250	1/800	
E	TV/2, 1915	Para A	•	•	•	1/250	1/5	1/5	
F	—	Normal	•	•	•	•	•	•	Serum early in case. Para A isolated from blood
G	•	Enteric group	•	•	•	1/800	1/500	1/2500	Not inoculated. Never had enteric or dysentery
H	•	Dysentery	<1/20	<1/250	<1/40	•	•	•	Pooled serum
I	•	Dysentery	<1/20	<1/40	<1/40	•	•	•	Serum of case in No. 10 Series
J	•	Enteric group	•	•	•	1/300	1/750	1/250	Serum of Case 16 in series agglutinated homologous organism, 1—60
	TAB, 1916	Dysentery	<1/25	<1/40	<1/40	1/12,500	1/50	>1/800	Pooled serum
L	TAB, 1916	Dysentery	<1/20	<1/40	<1/40	1/2500	1/80	1/800	Homologous organism quite atypical, agglutinated by serum, 1—250
M	—	Normal	—	—	—	—	—	—	An organism isolated from case giving Flexner-Y sugars, agglutinated 1—126 with serum
									Not inoculated. Never had enteric or dysentery

• Not known.

Captain Sladden has kindly provided most of these sera together with their agglutination titres as shown by Dreyer's method. In all cases the agglutinations of the antigen emulsions have been tested with specific

dysentery and enteric sera prior to the tests. Two groups may be distinguished on the agglutination. The first comprises the strains 1 to 7 in Series I which no longer showed the phenomenon of multiple agglutination in 1 in 300 dilutions of specific enteric sera.

The second group comprises the recently isolated strains 8 to 18 in Series II, in which the phenomenon of multiple agglutination was still well marked in dilutions of 1 in 300 specific sera. This distinction of two groups is made as it was supposed that fixation of the complement tests might show some relation between the phenomenon of multiple agglutination and enteric group agglutinins.

The object of these fixations of the complement tests was therefore two-fold: First, to ascertain the relation of these strains to the dysentery group; second, to ascertain the relation of the phenomenon of multiple agglutination to the presence of homologous agglutinins in a serum.

In Table VI are shown the various sera used, their source and titres.

These are lettered alphabetically and referred to as lettered. In Table VII are shown the strains of organisms and their agglutinations prior to the tests.

TABLE VII.—STRAINS OF ORGANISMS USED IN FIXATION OF COMPLEMENT TESTS.

No. in series	Agglutination end-points with specific sera diluted 1/100 up prior to tests					Remarks
	Microscopic method					
	Shiga	Flexner-Y	Typhoid	Para A	Para B	
4	—	1/300	—	1/100	—	..
5	—	1/300	—	—	—	..
6	1/200	1/1200	1/300	1/200	1/200	Agglutinations with enteric group sera very feeble
7	—	1/600	1/200	1/100	1/100	Complete typhoid agglutination 1/100; A and B feeble
10	—	1/600	1/600	—	—	Agglutination strong
13	—	1/1200	1/300	1/300	1/300	" "
15	—	1/300	1/600	1/600	1/300	" "
16	1/200	1/600	1/600	1/600	1/1200	" "
Strain X	—	—	—	—	—	Proteus group used as a control antigen
18	—	1/1200	1/600	1/600	1/600	Agglutination strong

The several tests made are shown in the various tables which follow.

In Table VIII two dilutions of complement were used, in all the other tests three dilutions were used.

Before summarizing the results of the antigen tests in the preceding tables there are a few practical points of importance in reference to technique which may be outlined.

The method used throughout is similar in principle to the one used in Wassermann tests in the British venereal hospitals in France.

TABLE VIII.

Serum	LIVING ANTIGEN		
	Serial number of antigen		
	4	6	7
Anti-dysenteric (therapeutic)—A..	++	++	± ±
Para B infection—B	++	± ±	± —
Para B infection—C	± ±	± —	—

M.H.D. of complement .. 1—45.

Dilution in test 1—9 and 1—13.

TABLE IX.

Serum	LIVING ANTIGEN			Strain X
	Serial number of antigen			
	4	6	7	
Anti-dysenteric (therapeutic)—A..	+++	+++	± ± ±	—
Para B infection—D	—	—	—	—
Para A infection—E	—	—	—	—
Normal—F'	—	—	—	—

M.H.D. of complement .. 1—45.

Dilution used 1—9, 1—12, and 1—14.

TABLE X.

Serum	KILLED ANTIGEN			
	Serial number of antigen			
	4	5	6	7
Anti-dysenteric (therapeutic)—A..	+++	+++	+++	+++
Enteric group—G	± ± ±	—	+++	—
Para A—E	—	—	—	—
Normal—F	—	—	—	—

M.H.D. of complement .. 1—50.

Dilutions used 1—10, 1—12 1—14.

TABLE XI.

Serum	KILLED ANTIGEN	
	Serial number of antigen	
	10	13
Anti-dysenteric (therapeutic)—A..	+++	+++
Dysenteric, Case 10, Flexner type —H	+++	+++

M.H.D. of complement .. 1—40.

Dilution used 1—9, 1—11, 1—12.

TABLE XII.

Serum	KILLED ANTIGEN					
	Serial number of antigen					
	Strain X	10	13	15	16	18
Dysenteric, Case 16, Type atypical—I	—	+++	+++	+++	+++	Not tested
Enteric Group—J	—	+++	± 7 Tr	+++	+++	„
Dysentery, type atypical—K ..	Not tested	+++	Not tested	Not tested	+++	„
Dysentery, type Flexner-Y—L ..	—	+++	+++	+++	+++	„
Normal—M	—	—	—	—	—	—
Anti-dysenteric(therapeutic)—A..	—	+++	+++	+++	+++	+++

M.H.D. of complement .. 1—45.

Dilutions used 1—8, 1—10, 1—12.

Attention has already been drawn to the occasional presence in a living bacillary antigen of a hæmolyisin; this appears to be eliminated by using emulsions which have been killed at 60° C.

One in five dilutions of fresh serum from dysentery or enteric group patients are quite satisfactory, but if such serum is kept at a room temperature (without special aseptic precautions) the serum becomes uncertain and may of itself deviate all complement used in the test proper.

It was found necessary in the case of therapeutic sera to use a dilution of 1/7 or 1/8, as a dilution of 1/5 occasionally brought about partial absorption of complement as shown by incomplete hæmolysis in the test control tubes; it is therefore very advisable to put up serum controls before proceeding to the general test, in which such controls are nevertheless included. In every case it is necessary to test the deviating power of the bacillary antigen; strong emulsions will completely deviate all the complement necessary for the tests proper.

Emulsion containing 4,000 million bacilli per cubic centimetre was found to be a useful average strength; the emulsions are made in saline from eighteen-hour agar slopes without the addition of an antiseptic.

SUMMARY OF RESULTS OF COMPLEMENT FIXATION TESTS.

(A) Seventeen tests with antidysenteric serum gave: Fifteen complete positives; two incomplete.

(B) Twelve tests with sera from clinical cases of dysentery gave: Twelve complete positives.

(C) Twenty-four tests with enteric group sera gave: Five complete positives; six incomplete; thirteen negatives.

(D) Twelve tests with "normal" sera gave: Twelve negative.

(E) Nine tests made with an antigen of the proteus group against the above sera gave: nine negatives.

168 *Some Strains of Organisms found in Dysentery Cases*

The nine strains tested therefore show almost complete uniform positive results with dysentery sera.

The dysentery sera and strains of organisms used in the tests may be summarized as follows (see Tables II, VI, and VII).

DYSENTERY SERA. FOUR VARIETIES (TABLE VI).

(1) A. Therapeutic antidysenteric agglutination Dreyer's standard emulsions.

(2) H. Clinical case of dysentery (Case 10 in Series) agglutination Dreyer's standard emulsions. Homologous organisms isolated Flexner-Y.

(3) L. Clinical case of dysentery. No agglutination of Dreyer's standard emulsions. Homologous organism isolated Flexner-Y, and was agglutinated by serum 1 in 125.

(4) I. and L. Clinical case of dysentery (serum 1 from Case 16 in Series).

No agglutination of Dreyer's standard emulsions. Homologous organisms isolated quite atypical and were agglutinated by sera.

In all cases the homologous organisms isolated showed the phenomenon of multiple agglutination.

The nine strains used as antigens fall into three groups on sugar fermentations.

(1) Flexner-Y. One strain (No. 10).

(2) Aberrant. Four strains (Nos. 4, 5, 6, and 7).

(3) Quite atypical. Four strains (Nos. 13, 15, 16 and 17).

With the exception of No. 5, all strains showed the phenomenon of multiple agglutination.

As regards the tests with the enteric group sera the result seems to depend to a great extent on the agglutinability of the strains and the titre of the serum; in view of the lack of complete uniformity of results in this respect no definite conclusions can be drawn from so few tests. It is to be noted that with one exception (Serum E, Table VI) the proof of enteric group infection in the cases providing the serum depended on agglutination curves complicated in most instances by triple enteric group inoculation. Serum E, although taken from a definite case of paratyphoid A infection which had received typhoid inoculation only, gave a low agglutination titre and all antigen tests with this serum were negative. Strain 5, which did not show the phenomenon of multiple agglutination, was the only strain that showed complete negative results with the enteric group sera. The provisional deductions are put forward that these agglutinable strains will deviate complement in the presence of homologous agglutinins and that such deviation—being proportionate to the degree of agglutinability of the organism and the titre of the agglutinins in the serum—is not a specific reaction other than an agglutination phenomenon. Further, if a known infective serum and a bacillary antigen giving agglu-

tion homologous to the infection, will deviate complement only in proportion to the agglutinability of the organism and the titre of the agglutinins, such deviation is not only no proof of the specificity of the antigen, but rather evidence to the contrary—since the presence or absence of agglutinins in an infective serum is no indication of the true antigen immune bodies in that serum. Compared to the tests with enteric group sera, all the antigen strains tested with dysentery sera give very clear-cut positive results—not only with known serum (antidysenteric) but with suspect sera (clinical cases). Three of the four clinical dysentery sera used did not agglutinate “standard” dysentery emulsions; the positive tests might, therefore, appear to be independent of dysentery agglutinins and to be a specific true antigen-immune body reaction, but these sera contained enteric group agglutinins and the antigen strains showed homologous enteric group agglutinability to which the positive results may possibly be due. It cannot therefore be claimed that these results are true antigen immune body reactions independent of dysentery agglutinins in the serum. For the same reason positive results with known dysentery serum (therapeutic) which showed high titre dysentery agglutinins only, may possibly be an antigen-agglutinin phenomenon and not a true antigen immune body reaction.

None of these antigen tests can therefore be said to establish the specificity of any of the antigen strains. All that can be said is that these strains give with enteric group sera complement fixation results which appear to be an antigen-agglutinin phenomenon, and that with dysentery sera they give positive results which cannot be accepted as true antigen-immune body reactions, in view of an antigen-agglutinin phenomenon which is superadded.

IMMUNITY EXPERIMENTS.

Two rabbits were immunized with Strains Nos. 6 and 10 respectively. The object of the experiment was to ascertain the specificity of the strains by the agglutinins produced by inoculation in the rabbit's serum. The toxicity of the organisms being unknown, very small doses were commenced with; this is very necessary with dysentery organisms, which are very toxic for rabbits.

Emulsions from eighteen-hour agar slopes were killed at 58° C. for half an hour on two successive days and carbolized. The inoculations were given subcutaneously at five-day intervals.

Rabbit 1.—Strain 6. (For agglutination see Table VII.) Inoculated 15, 30, 80, 200, 500, and 1,000 millions at five-day intervals. The rabbit was in no way disturbed by the injections.

Rabbit 2.—Strain 10. (For agglutinations see Table VII.) Inoculated 15, 100, 250, and 500 millions at five-day intervals. The rabbit was in no way disturbed by the injections.

The sera of the two rabbits on the second day after the last injection

170 *Some Strains of Organisms found in Dysentery Cases*

were tested for agglutination by Dreyer's method, using "standard" typhoid and dysentery emulsions and emulsions of the antigens. The following Table XIII gives the agglutination end-points.

TABLE XIII.

	Antigen	T	Para A	Para B	S	F	Y
Rabbit 1, Strain 6 ..	Tr. 50	< 25	< 25	< 25	< 25	< 25	< 25
„ 2, „ 10 ..	> 1,000	< 25	< 25	< 25	< 25	250	< 25

The result is very interesting.

In neither case has inoculation produced any enteric group agglutinins. Antigen Strain No. 6 has produced slight homologous agglutinins, but none for the typhoid or dysentery groups. This strain gave Gaertner fermentations, and was strongly agglutinated by specific Flexner-Y serum (Tables I and II). Antigen Strain No. 10 has produced strong homologous agglutinins and agglutinins for *B. dysenteriae* Flexner of the same titre as the patient's serum from whom the strain was isolated.

This experiment is of particular interest, because the strain was equally agglutinated by specific typhoid and Flexner-Y serum (Tables I, II, and VII), and inoculation has produced no agglutinins for typhoid.

The conclusions from these two experiments are, therefore:—

- (1) These strains are not related specifically to the enteric group.
- (2) Enteric group agglutinability, as shown by these strains, is non-specific; the property is an acquired one.
- (3) Strain 10 is a specific dysentery organism type Flexner, toxicity very slight.
- (4) Strain 6 is probably non-specific, toxicity practically nil.
- (5) The dysentery agglutinability of Strain 6 is probably non-specific, and the property is an acquired one.

THE PHENOMENON OF MULTIPLE AGGLUTINATION.

This was present in every strain except Nos. 5 and 9. Whether this phenomenon is common to particular strains of intestinal organisms under certain conditions cannot be stated. In this series multiple agglutinability was only tested on those strains which in the first instance agglutinated with specific dysentery sera; it has therefore yet to be shown whether this phenomenon is found in any conditions not associated with dysentery. Every case, where inquiries were made, had received typhoid inoculation; it is almost certain that the majority had also received the triple inoculation which has now been in use for more than a year. It is therefore suggested that this phenomenon, so far as the enteric group agglutinations are concerned—whatever its significance may be—is closely

associated with, if not actually due to, typhoid inoculation. No explanation is offered, but it is suggested that certain strains of intestinal organisms, whether specific or not, are capable in inoculated individuals of being rendered agglutinable under the influence of the antibodies produced by the inoculation.

Until further observations have been made, there is no proof yet available that the majority of the strains of organism in this paper belong to the *B. dysenteriae* group. It is true they agglutinate more strongly with specific dysentery sera in the majority of cases than they do with specific enteric group sera, and that this agglutinability persists while that for specific enteric sera disappears. Beyond this no further claim can be made for those strains which do not conform to well-established fermentation tests. The same suggestion which has been offered for the phenomenon of multiple agglutination with the enteric group holds also with the dysentery group, except that, in the latter case, the phenomenon is due to infection with a specific organism, and not due to inoculation.

That these atypical strains are not *B. dysenteriae*, but intestinal organisms sensitized and rendered agglutinable to specific dysentery sera is supported by the facts that:—

(1) The strains were isolated in every instance from cases with a clinical history of dysentery.

(2) They were isolated in the vast majority of cases from individuals passing normal stools, and in many instances seemingly fit—conditions contrary to general experience.

(3) The fermentation tests are in many cases unrelated.

(4) One strain (No. 10, Table I) agglutinated equally well with typhoid serum, two strains (Nos. 15 and 16, Table I) gave stronger enteric group agglutinations than they did dysentery.

(5) Immunization of a rabbit with an atypical agglutinable strain produces no specific agglutinins.

All strains showing multiple enteric group agglutination were associated with high enteric group agglutinins in the homologous sera, but not in all cases did the sera contain agglutinins for standard dysentery emulsions. That is to say the homologous serum of strains which showed agglutination with specific dysentery sera in some instances gave no agglutination with specific dysentery organisms. If one were dealing with known typical dysentery strains, this factor is of no importance, because specific organisms agglutinating with specific sera are generally present in the infection some time before homologous agglutinins appear. If, then, these atypical strains here described are to be excluded from the *B. dysenteriae*, and if their agglutinability with specific dysentery sera is to be explained on the grounds previously suggested, then it must be presumed that this agglutinability as a phenomenon is not due to the agglutinins in the serum of the infective person, but to some other factor in the infective process.

THE FERMENTATION REACTIONS.

The behaviour of the sugars with these organisms is extraordinarily varied. Even the lactose fermenters do not conform to any special type of intestinal organism. It seems unreasonable to suggest that in a comparatively small number of cases so many different strains should be present all of which possess certain similar specific characters.

Two possibilities therefore suggest themselves; either the atypical strains are specific organisms which have acquired atypical fermentation characters, or they are non-specific organisms of the intestinal tract which have acquired certain specific properties and fermentation characters atypical of any well-defined non-specific group. All the atypical non-lactose fermenting strains conform in other cultural respects to *B. dysenteriae*, they do not liquefy gelatine, they are non-motile Gram-negative bacilli and give the characteristic milk reactions of the group—early acid followed by alkalinity. Two of these strains give the fermentations of the Gaertner group but do not agglutinate with specific Gaertner serum. Sugar fermentation tests have been repeated with most of these strains—in some instances six weeks after first isolation; as far as these tests have gone there has been no reversion.

GENERAL CULTURAL PROPERTIES.

All the strains except Nos. 4 and 5 grew readily on ordinary media; confluent colonies form a moist, rather slimy growth which shows no tendency to spread beyond the area inoculated. Of the early strains all except Nos. 4 and 5, which have died out, are still alive after more than two months at room temperature during the winter.

GENERAL SUMMARY.

Two hundred and sixty-three stools were examined for dysentery and gave fifty-eight positive results on agglutination tests only.

TABLE XIV.

Stools examined	Dysentery. Agglutinable growths	Agglutinable strains isolated	
		Non-lactose fermenting	Lactose fermenting
Series I—143 ..	31	7 { 3 Flexner-Y type 4 Aberrant }	Not sought
„ II—120 ..	27	6 { 4 Flexner-Y type 2 Aberrant }	5
Total 263 ..	58	13	5

All the strains isolated showed, with two exceptions, the phenomenon of “multiple agglutination.”

This phenomenon is regarded as a non-specific feature of these organisms as regards the enteric group for the following reasons:—

(a) The patients were not suffering from enteric group infection as understood.

(b) Agglutination with specific enteric group sera occurred with several sera of the group, did not occur in most instances in high dilution and tended to disappear early (Table I).

(c) Complement fixation tests with enteric group sera gave no proof of specificity, the positive and incomplete tests seem to depend on agglutination factors and are regarded as an antigen agglutinin phenomenon and not a true antigen immune body reaction (Tables VIII to XII).

(d) Immunity experiments with two strains produced no enteric group agglutinins in the rabbits inoculated.

In all cases investigated multiple agglutination was associated with high titre enteric group agglutinins in the homologous sera of individuals who had received triple typhoid inoculation. It is therefore considered that this phenomenon is not a specific peculiarity of any particular strain or group, but rather the resultant of some factor such as inoculation.

Most importance should be given to those considerations which bear on the practical side of the dysentery question, as affecting the forces in France. Whether a particular infection is or is not due to a true *B. dysenteriae* is of importance. In acute or active cases of dysentery, it is important for epidemiological reasons to know if the infective agent is of a particular strain. Infective localities can be mapped and the spread of epidemics can be followed and anticipated with the aid of the laboratory. Of almost greater importance possibly is the carrier question. An active case of dysentery is infective during the active stage and needs no laboratory evidence to support the obvious clinical condition. But when a case of dysentery has recovered and is physically fit for duty, accurate bacteriological diagnosis is of first importance, for the disposal of that individual depends on the laboratory findings. It is very important that no carrier be set free to aid as a new focus for the infection of others, it is also important that all "healthy" men be returned to duty as soon as possible. It is not claimed in this paper that the atypical strains described are dysentery organisms. Possibly they may be recognized types which have been modified by various extraneous conditions, or new strains which have so far escaped notice; that this is possible has not been disproved.

From a practical point of view it is considered that the question of whether these dysentery agglutinable strains are or are not *B. dysenteriae* is not of paramount importance in the early diagnosis of the disease where a diagnosis can be made on clinical grounds. But an accurate bacteriological diagnosis is required for the diagnosis of carriers.

At this Base where the agglutination from plate method has been largely used for the diagnosis of dysentery, it has been noticeable that positive results with this method are relatively infrequent during the acute stage of the disease, but become frequent when patients become convalescent. This corresponds with what has been noted early in this paper,

174 *Some Strains of Organisms found in Dysentery Cases*

that agglutinable strains were present in cases the majority of whom were passing normal motions.

As pointed out before, isolation of true *B. dysenteriae*, once the motions have become normal, is infrequent.

It may possibly be urged that all cases from which atypical dysentery organisms have been isolated should be regarded as potential carriers. It has been pointed out that in the second series of 120 cases, 11 agglutinable strains were recovered from 27 plates which gave agglutination. The other sixteen plates were subcultured direct from the plate and from the emulsions with which the agglutination tests were made, but no agglutinable colonies or growths were found in subcultures. It is therefore suggested that the failure to find agglutinable strains in subculture was not due to failure to isolate the original strain, but to loss in subculture of agglutinable properties on lines precisely analogous to what has been found with the enteric group agglutinability of the strains described.

Analysis of Table XIV gives the following figures :—

	Per cent
(1) Total positive cases returned on agglutination tests only.. ..	21·67
(2) Total agglutinable strains isolated (series No. 2 only)	9·16
(3) Total non-lactose fermenting agglutinable strains isolated	4·94
(4) Total typical <i>B. dysenteriae</i> isolated	3·04

The laboratory returns therefore show a jump from 3·04 per cent to 21·67 per cent according to the various standards of what is regarded as specificity.

It has been shown that agglutinability can be a phenomenon of no specific importance, and it is suggested that this property may be acquired by non-specific organisms as the result of specific infection.

One atypical strain has been shown by an immunity experiment to be probably non-specific. The probability is that the atypical strains are all non-specific; it is possible that the only specific property they possess—agglutinability with specific sera—is an acquired one and no proof of specificity.

The conclusions therefore are :—

(1) Agglutinability alone provides no proof of the specificity of an agglutinable organism which does not conform to cultural tests.

(2) Diagnosis dependent on agglutination tests only is not applicable to carriers for the reason that a large number of positives will be returned on totally inadequate bacteriological grounds.

(3) Should the suggestion that the agglutinability of heterologous bacteria affords proof of specific infection be confirmed and controlled by further observations, it may become possible to diagnose infection from the examination of bacteria in mixture from plate cultures.

PYREXIAS OF DOUBTFUL ORIGIN IN AN INFANTRY BATTALION ON ACTIVE SERVICE.

BY THE LATE CAPTAIN C. K. MCKERROW, M.B.

Royal Army Medical Corps.

Medical Officer of — Battalion, Northumberland Fusiliers

WITH A

FOREWORD

BY COLONEL R. J. BLACKHAM, C.I.E., D.S.O.

Army Medical Service.

A.D.M.S. — Division.

FOREWORD.

A MELANCHOLY interest attached to this paper as it was read before a Division Medical Society by the author a short time before his death.

Had the author lived it would have been submitted as his thesis for the degree of Doctor of Medicine, Cambridge University. At the time when he was wounded Captain McKerrow was actually making a fair copy from the rough notes from which he read before the Divisional Medical Society, and his widow has completed the paper from these notes. Dates and names of persons and places only have been omitted.

Leaving his wife and his practice at the beginning of the War, he became the Regimental Medical Officer of a famous Fusilier Regiment and rapidly made himself a power in the battalion.

His quick brain soon adapted itself to military methods and he became a part of our great national military system, but becoming a soldier he did not cease to be a doctor, and he saw that even work with a battalion in the field gave facilities for what must, for want of a better term, be called "clinical work."

His study of obscure fever cases during the scanty leisure of the medical officer of a battalion which has been fighting almost continuously for a year and a half reveals the possibility of medical study even in the front line trenches.

Captain McKerrow's work is not only a valuable contribution to medical literature but an inspiring example to other medical officers of the possibility of using the clinical material constantly passing through their regimental aid-posts and medical inspection rooms.

Captain McKerrow was mortally wounded in action. His study of clinical work with a battalion on active service will remain as a memorial of a very gallant soldier and a truly skilled physician.

R. J. BLACKHAM, *Colonel,*

A.D.M.S. — Division.

176 *Pyrexias of doubtful Origin in an Infantry Battalion*

THERE has been much speculation during the past year as to the nature of those pyrexial illnesses, which form so large a proportion of the total morbidity of the British Army in France and Belgium and in which the origin of the pyrexia is obscure. The literature on the subject has been extensive and has disclosed the great differences of opinion that exists amongst those who are brought into contact with such cases. The base hospitals, the casualty clearing stations and field ambulances have each published interesting observations based on their personal experiences of such pyrexias. The regimental medical officer has alone been silent. It is a generally accepted opinion that the nature of the conditions under which these officers work renders clinical observation or accurate records impossible. Such is really not the case nowadays whatever it may have been formerly. Time and opportunity for studying his cases are abundant and he has the unique advantage of being able as a rule to follow through many months the subsequent careers of his patients. This seems to me sufficient reason that he also should add his contribution to the discussion.

The records which I have kept include all illnesses which occurred in the — Northumberland Fusiliers, since coming to France on August —, 1915, and which were of sufficient importance to make a man "go sick." The chief symptoms of each case were noted and its subsequent course followed as far as possible. When a man was evacuated to hospital and did not rejoin the unit some details of his illness were often obtainable from himself and from his friends. Men were visited when in hospital whenever circumstances permitted. Men who were kept with the unit were generally kept in the aid-post under constant observation till a definite opinion was formed of their illness. The great improvement in our aid-posts during the latter part of this year has rendered this more and more possible.

These records show that during the fifteen months from September, 1915, to December, 1916, there were 365 cases of pyrexia in the battalion for which no definite cause could be found. This leads naturally to the question as to what is to be considered the dividing line between causes which are definite and those that are indefinite. The cause of the pyrexia in a case of typhoid, of tonsillitis, or of pneumonia, is sufficiently obvious and will cause no argument, being referred respectively to the entry of toxins into the blood from the intestine, the throat or the lung. It is the less definite cases which render judgment difficult. Suppose a man develops a slight cough and a rise of temperature. Are we to consider his cough as sufficient reason for condemning his nasopharynx as the focus from which the temperature-raising toxins spread? Some might consider it equally reasonable to regard the pyrexia as the cause of the cough. I have consequently been compelled to include in my series many cases in which greater facilities or knowledge would possibly have produced a more exact diagnosis. I have excluded all cases where the cause of the pyrexia was at all probable, such as marked nasopharyngeal, bronchial or intestinal infections.

The total number of really doubtful cases which occurred in the battalion during fifteen months was 365; of these 210 were treated entirely with the unit, and 155 were sent at some period of their illnesses into the field ambulance; of the latter 52 have never rejoined. This as a rule means that the man had been evacuated out of the divisional area owing to the obstinacy of his illness. This does not hold good during very active operations when men are readily drafted to other units. It has been in most instances possible to obtain some records of the course of the illnesses from which these men suffered, but much reliance cannot be placed on them.

The cases which are labelled P.U.O., N.Y.D., influenza or trench fever form at present a large proportion of the sick of most divisions. There seems every reason to believe that such labels cover a variety of infections. The only possible way of separating one from another without the aid of the bacteriologist is to group the cases according to their symptoms and their natural history. The records I have kept are in many respects deficient but they give the main symptoms of each case both at its onset and during its course. The results of the illness on the man's subsequent health have been observable generally for many months.

The first point to consider is how do these cases start.

The symptoms are in my experience separable into four groups.

The first group consists of men who complain of pains all over. They often say that they feel as if they had been beaten. They generally have a frontal headache, but it is seldom very severe. The pain is usually most severe in the back, the glutei, the neck and the thighs. It is referred definitely to the muscles and they are tender when firmly pressed. There is often slight constipation which responds readily to treatment. The face is generally flushed, the eyes dull and the tongue slightly furred. The temperature in the mouth is usually above 101° F. and often above 103° F. In sixty per cent of my cases with such general muscular pains there was some congestion of the fauces and a slight cough. In twenty-four per cent there was some purulent nasal discharge and in four per cent there was slight herpes labialis.

The men always say that their attack came on suddenly. A very common complaint is that they suddenly "went cold." I have seen one case starting with a slight rigor.

C. T., a stretcher-bearer, started to take a man to the field ambulance which was half a mile away. He was feeling quite well. Before he had one half-way he felt very cold and shivering, so came straight back. He was pale and had a slight rigor. His temperature was 103° F. He had slight congestion of the fauces with a short infrequent cough. He complained of great pain across his lumbar muscles and in the thighs. He had a frontal headache, but it was not severe. He said that his throat had not felt sore and that the cough did not trouble him.

This is a very typical case of the first mode of onset. There were 166 cases of this type, that is, forty-five per cent.

178 *Pyrexias of doubtful Origin in an Infantry Battalion*

The second class comprises the men who come to sick parade complaining of their legs. They sometimes have a headache which is generally frontal when present and occasionally is severe. Nasopharyngeal symptoms are generally absent, but about ten per cent have a slight cough. There is sometimes constipation, but it is unusual. Four per cent of my cases had slight diarrhœa. As a rule these men are pale and look as if they were in pain. The temperature is generally below 102° F. when the man first comes sick. In many cases it is below 100° F. Daily fluctuations are usual, and a man who comes sick with a temperature of 99° F. in the morning has not uncommonly a temperature of 102° F. by the evening. Some cases show a normal temperature in the earlier part of the day which may lead to mistakes unless the evening temperature is also taken. In a few cases the temperature is highest in the morning. The pains complained of in the legs are very typical. One man said that it felt as if his shin bones were being scraped with a knife. Pressure over the tibiæ is acutely painful at certain spots, a very common one being about four inches above the ankle joint. As a rule, both legs are equally tender at the onset. In three per cent of my cases with shin-pains there was also great tenderness to pressure over the lower end of the femur in the region of the adductor tubercle, and in two per cent at the origins of the gastrocnemii.

The pains always get worse at night. The men say that as soon as they get warm in bed the pains increase. I have never seen any outward change in the painful parts.

The onset of these cases seems somewhat variable. I have seen cases start with great suddenness. My sick corporal was perfectly well at 7 a.m. At 9 a.m. he had severe pains in his shins and head. His temperature was 100° F. by the mouth. By the evening the pains in his legs were almost unbearable, and his temperature was 102° F.

On the other hand, some cases start gradually. Cpl. D., of D Company, came to sick parade on August 16 complaining of pains in his shins, which he had had three days. He had a slight headache. His temperature was 99° F., and he was excused duty. He did not go sick again till the 26th, when he came with the same complaint and a temperature of 101° F. He was sent into hospital, and was away three weeks. He had a relapse while there. Some men come to sick parade complaining of shin-pains, but show no rise of temperature at any time of the day. These cases do not come under the heading of pyrexias of uncertain origin, but they are of interest as suggesting that there is an apyrexial form of this type of case.

In my series there were 132 men whose chief complaint was the pain in their shins, that is to say, thirty-six per cent of the total number of cases.

The third type of case complains of his head, and his head only. This is so common a complaint in all pyrexias that this group probably includes a variety of illnesses. About 40 per cent of these cases show some slight nasopharyngeal congestion, and some develop general muscular pains; 14 per cent developed definite shin-pains; 16 per cent were sent into hospital,

and did not return. The remaining thirty per cent cleared up rapidly, and gave no clue to their nature. The headache complained of is generally frontal, and in some cases was very severe, especially in those men who later had shin pains. The pyrexia is generally moderate, and the onset of most of the cases was sudden.

The number of cases of this type was fifty-five, that is fifteen per cent.

The fourth class of case complains of weakness. When he first comes sick, he has no pains of any description. The temperature is generally below 100° F., and the man looks pale and tired. He generally says that his illness started gradually. There were only thirteen of these cases, that is, 3.5 per cent, but a point of interest about them is that eight developed shin pains, and were evacuated. The other five had no definite symptoms except weakness, and cleared up satisfactorily. If there is such a thing as the pyrexia of exhaustion, these five cases might be regarded as suffering from it, for they all occurred immediately after a period of great strain.

Such are the four types of onset of these cases according to my experience. What course do they run? As I mentioned previously, 210 out of my series of 365 cases, that is, 57 per cent, were treated entirely with the unit. Those who know the conditions of life with an infantry battalion will realize that this means that fifty-seven per cent of men suffering from pyrexias of uncertain origin recover rapidly, and, at any rate, sufficiently to "carry on."

But the proportion of rapid recoveries is even greater, for of the 155 men who were sent into hospital, forty-six rejoined their unit within fourteen days.

These are often cases which have to be evacuated owing to military reasons such as active operations or reliefs. We find, therefore, in this series of cases that seventy per cent recovered rapidly, and thirty per cent proved more obstinate.

The treatment of all the cases was essentially the same. Salicylates were administered in ten-grain doses every four hours, a purge, if necessary, no food, but lots of hot water. This was persisted in for twenty-four hours. If there was no improvement, then the man was sent into the field ambulance.

The manner in which the different types of case react to such treatment is interesting. Of the first type, the men who have general muscular pains, and often a slight cough and headache, 138, that is, 83 per cent, recovered rapidly and completely; 20 cases, that is, 12 per cent, were in hospital some time, or did not return to us; 5 per cent returned from hospital, but had relapses.

Of the second type, the men with shin-pains, only 15 cases, that is, 11 per cent, recovered rapidly and completely; 64, or 48 per cent, were long periods in hospital, or did not return to us. In more than half of these, there were reported to have been relapses. Fifty-three cases, that is, forty-one per cent, had definitely observed relapses while with the unit. Some

180 *Pyrexias of doubtful Origin in an Infantry Battalion*

of these occurred after the men returned from hospital. Several men had two or more of these relapses, and one man was sent into hospital three times in a month.

Of the third type, *men with headache and pyrexia, seventy per cent cleared up rapidly and completely; sixteen per cent went into hospital, and did not return. It is known that several of these recovered rapidly, but were drafted to other units; fourteen per cent developed pains in their shins, and had relapses.

The fourth type, men complaining only of weakness, form a small proportion—1·5 per cent of the whole series. There were thirteen cases in all; five of these cleared up quickly and completely with rest. The remaining eight were sent into hospital, and two did not return. The other six all developed pains in their shins, and proved remarkably obstinate, having several relapses.

The conclusion which this analysis of the history of these cases suggests is that the obstinate case is essentially the one in which shin-pains occur at some period of the illness. Of 146 cases of this type only fifteen, or ten per cent, proved easily curable. On the other hand, the man with general muscular pains, a fairly high temperature, often a cough, and generally a headache, appears to respond well to treatment. Nearly ninety per cent of these cases rapidly and completely recovered.

There are other essentials in which the shin-pain type of case appears to differ from the others. One is in their reaction to salicylates. It is often found that the man with general muscular pains is greatly relieved by even ten grains of salicylate of soda or aspirin. As a rule, he perspires freely, and his temperature falls. The man with severe pains in his shins will often find no relief at all from doses many times larger. Another point is that such cases do not in my experience perspire, nor does the temperature fall even after 40, 60, or 80 grains have been given.

Another characteristic of the case with shin-pains is its liability to relapse. The man appears very much better, the pains disappear to a great extent, the temperature falls, and then quite suddenly all the symptoms return, often with increased intensity. Before this tendency to relapse was realized, the field ambulance incurred much undeserved abuse. Men were constantly being returned to their units as cured, and then showed a temperature of 100° F. the same night or the next morning with a return of their pains.

In my series there were 68 men who had recurrences, several more than one. Of the 68, 53, that is, 78 per cent, were men who had definite shin-pains at the commencement of their illness; 6, that is about 9 per cent, who, though they "went sick" with some other complaint, developed such pains later. This means that eighty-seven per cent of men with known recurrences were men who suffered from pains in their shins. The remaining thirteen per cent were men who complained of general muscular pains, weakness, or headache, but did not have any definite shin-pain.

The proportion of each class of case, which relapse is difficult to decide very exactly owing to the fact that a coherent account of a man's illness in hospital is hard to obtain. In my series forty-seven per cent of all cases with shin-pains, but only five per cent of the men with general muscular pains, were known to have recurrences.

A small proportion of my cases had general muscular pains combined with severe pains in the shins. In these the general pains preceded the shin-pains generally by at least a day. These men generally said that their illness had "settled in their legs."

Serjt. B. came sick on November 16 with severe pains in his head, back and thighs. He had a slight cough with some faucial congestion. His temperature was 102.4° F. We were moving the same day into the line so he was sent into hospital. This was apparently a case which would be expected to recover quickly. He was sent back to the unit on December 3. He said he had no pains but felt rather weak. Next day he came sick complaining of pains in his shins. There was marked tenderness down each tibia. His temperature was 100° F. in the mouth. He was kept in the aid-post for three days and treated with salicylates. Neither the pains nor his pyrexia were much relieved and he was again sent into hospital, where he now is.

Such cases seem to combine general muscular pains with shin-pains and recurrence. In my experience they are uncommon, as only five per cent of the 166 cases, where the original complaint was general muscular pains, later developed shin-pains.

The conclusions which these clinical facts suggest are :—

Firstly.—That cases of pyrexia of doubtful origin occurred very commonly amongst the men of the unit we are considering during fifteen months in France and Belgium.

Secondly.—That almost two-thirds of such cases were never evacuated and that about three-fourths of such cases clear up rapidly and completely.

Thirdly.—That the cases which prove obstinate are, as a rule, those of men with pains in their shins.

Fourthly.—That such shin-pain cases show definite characteristics both in their tendency to relapse and in their response to treatment.

The incidence of these cases in the battalion both as regards time and place is also of interest. To study this it is necessary to give a short diary of the movements of the battalion during its fifteen months on the Western Front.

The battalion came to France at the end of August, 1915. The weather was hot and dusty. Flies were plentiful. On September 10 we went into trenches at P— for instructions with the —.

During September, there were four cases of P.U.O., all of the general muscular type. One was in hospital a week. The others were treated with the unit.

In October, we took over the trenches at O—. The first three weeks

182 *Pyrexias of doubtful Origin in an Infantry Battalion*

of the month were very wet and the trenches became rapidly waterlogged. There were not sufficient gum-boots and the men felt the cold and damp very much. In spite of this their health was remarkably good. There were six cases of P.U.O. Two were sent to hospital labelled as influenza. One came back quite well in ten days. The other developed bronchitis, was sent to England and eventually drafted to another unit. The other four were only ill for three or four days and did not leave the battalion. The chief complaints at that time were boils, lice, scabies and impetigo.

November, December and January were very wet indeed. The natives said they had not seen such rain for years. The River — was in fuller flood than for thirty years. The trenches were knee deep in mud and water. Most of the dug-outs fell in. The men were in trenches twenty-two days in each month and there were constant and heavy working parties.

During these three months there were only twenty-three cases of P.U.O. in the unit. There were several cases of acute bronchitis, pleurisy and chronic rheumatism. Of the twenty-three P.U.O.'s, thirteen were sent to hospital. They all returned in periods varying from four days to four weeks and remained quite well after their return. One of the cases had pains not unlike the shin-pain type. He rejoined the unit in ten days and has remained well since. The ten cases treated with the unit all cleared up in a few days.

February was rather drier but very cold. There were nine cases of P.U.O., all with general muscular pains, six were sent into hospital. All rejoined the unit within two weeks and remained well. The three men treated with the unit cleared up rapidly.

On February — the battalion moved back. We had a heavy march of twenty-three miles in the snow. Two of the P.U.O. cases with general pains occurred the following day.

March was very cold but fairly dry. Till the — we were in back area round Q — and —. During this period we had seven cases of P.U.O.

They all had general muscular pains. None were sent to hospital. On the — the battalion took over trenches at Z—. The trenches were very good but the sanitary condition of the town itself was very bad. There were three cases of P.U.O. from the 19th to the end of the month. Two had pains all over and one complained of weakness alone. One was in hospital four days. They all recovered quickly and had no relapses.

April was wet but warm. We were in trenches off and on till the 17th. During this period there were six cases of P.U.O. Four of these were men with general pains; one had pains in the legs only and one complained only of weakness. The latter was sent into hospital and has not returned. The others, including the man with leg pains, cleared up rapidly. The leg pains were definitely referred to the shins and were worse at night. This was the first case of the kind I had seen in the battalion. I thought at the time that the condition might be specific and tried large doses of potassium iodide with no effect. I also tested this and many subsequent cases for ataxia but found no signs of it. The knee-jerks were also normal.

The latter part of the month was spent in S—. During this period we had sixteen cases of P.U.O. Eight of these were men with general muscular pains and eight had pains only in their shins. Seven of the eight general pain cases were at duty in two days. The eighth developed shin-pains and was evacuated. He returned in five days as cured. Two days later his temperature was 100° F. and his pains were worse. This was the first relapse that I had seen.

The 8 cases who originally complained of pains in their shins comprised 4 who went to hospital and 4 who were cured with the unit. Of the former 1 did not return, 2 were away for several months and 1 came back in a week but had a severe relapse. On the 22nd of this month a case of paratyphoid was sent into hospital. This is the only diagnosed case of an enteric group infection which has occurred in fifteen months in this battalion.

On April 24 about half the men were inoculated fully with T.A.B.

April is of special interest as providing the first definite cases with shin-pains and with relapses. Another point of interest is that of the eight men who complained of shin-pains five were in No. 14 platoon. One occurred on the 25th, one on the 27th, and three on the 28th.

May was on the whole a dry month. We were in the back area round T— till the 18th. We then moved into trenches at V—. They were very dirty and offensive. There were 16 cases of P.U.O. in May, and 15 of these occurred while we were in the back area; 9 of the 16 were men with general pains, 8 of these cleared up in a few days. One was sent to hospital and did not return. Three men complained only of headaches. One cleared up quickly. One was sent into hospital and did not return. One developed shin-pains and was also evacuated.

Of the four others three had very definite shin pains. One was sent to hospital and did not return. One had very severe shin pains but only showed pyrexia for one day. He was treated with the unit but attended sick parade for about three weeks. My corporal thought the pains were due to the man having overtrained when a civilian. He had been a professional footballer.

One man had a definite recurrence with pyrexia and pains three days after returning to duty.

June was a good month. On the 3rd we left V— and were in the back area at U— till we moved to Y— at the end of the month.

The men were in good billets with lots of rest and were not overworked. There were, however, thirty-one cases of P.U.O. They were evenly distributed as regards date of occurrence, but not as regards distribution in the battalion. Four were in A Company and 4 in C, but there were 10 in B and 13 in D.

Nine men were sent to hospital and only two returned. One of these had a very definite relapse three days after coming back. Of the 22 men treated with the unit 18 were well within 3 days. In none had shin-pains

184 *Pyrexias of doubtful Origin in an Infantry Battalion*

been complained of. The other 4 comprised 3 men with definite shin-pains and 1 with weakness. All of these had recurrences and the latter developed shin-pains.

For the whole of July we were in Y— area. The weather was very wet at the beginning of the month but improved later. From the 3rd till the 19th the battalion was very actively engaged. There were 33 cases of P.U.O. in July, and of these only 9 were in the first half of the month; of these 9, 7 were men in the general muscular pain type. Two were sent into hospital and were drafted to other units. The others cleared up rapidly.

Of the twenty-four cases in the last half of the month there were only two with general muscular pains. Eleven complained of shin-pains only, six of headache and five of weakness.

There were 6 cases with definite relapses, 5 were shin-pain cases and 1 a weakness case. Three men with weakness and one with shin-pains were sent to hospital and did not return.

There did not seem to be any grouping of the cases according to platoons in July. There were a great number of men complaining of pains in their shins at the end of the month but only a small proportion of these "went sick."

The month of August was warm and bright; we were at Y—till the 7th, when we came out of the line and moved north to X—, where we were for the last two weeks of the month. There were 38 cases of P.U.O., 17 with definite shin-pains, 8 with headaches, 2 with weakness and the remainder with general muscular pains. Of the 17 shin-pain cases, 11 had marked relapses, 5 were sent to hospital and did not return. One cleared up easily. Of the headache cases three had recurrences and three were sent into hospital and have not returned. One weakness case cleared up rapidly, the other developed shin-pains and was evacuated.

This month is of interest for three things:—

The first was the occurrence of seven of the most obstinate cases I have seen. One man was in hospital on three separate occasions, and the others twice.

The second was the association of shin-pains with rather profuse diarrhoea in three men and with cystitis in two.

This may have been accidental.

The third, and this seems to me of special interest, was the sudden appearance of this shin-pain type of illness in the H. Q. Company. There had been no cases amongst them up to this. It must be remembered that as a rule their conditions are better than those of the men in the line, but on the — their conditions were as bad and sometimes worse.

On August 1, one of the H. Q. orderlies had a definite attack of shin-pains with pyrexia. He was not very bad and was kept with the unit. He had a very marked relapse on the 21st.

On August 17 one of the H. Q. signallers developed shin-pains. He was sent into hospital.

On August 26 the Colonel's observer was attacked. He had very severe shin-pains but remained with the unit as he was very anxious to do so. He had, however, two relapses, and had to be sent to hospital.

On the same day, the 26th, another H. Q. signaller went sick with pyrexia and shin-pains. He recovered quickly and was never very bad.

On the 29th the signalling corporal was attacked.

He could scarcely walk and could not sleep at night, owing to the pains in his shins. He recovered fairly quickly but had one relapse.

On the 31st another signaller was down with the same symptoms. He was laid up for two days with shin-pains and pyrexia, got apparently well, and then on September 11 had a definite relapse.

These cases seem to me of great interest because they appear to suggest very strongly the communicability of the disease. It is also possible that the telephone instruments may have carried the infection from signaller to signaller. This is of course mere conjecture.

September was a good month. On the 4th we left X— and returned to Y—. There were forty-one cases of P.U.O., of these twenty-six were men with shin-pains. Twelve of these had known recurrences. There were three cases in which shin-pains were associated with diarrhoea. All the cases without shin-pains, fifteen in number, were of the general muscular type.

Of the total number of P.U.O. cases this month twenty-two were in D Company. On the 21st of the month an officer was evacuated with dysentery. This was diagnosed later as a Flexner bacillus infection.

October was on the whole fine and fairly warm. We were at Y— till the 9th, when we moved north and took over trenches in the W—. These trenches were very wet and muddy towards the end of the month.

During October there were 71 cases of P.U.O., and 52 of these were men with shin-pains of varying severity. There were 19 cases of general muscular pain with slight coughs. All but one of these occurred during the last ten days of the month.

Thirty-seven men were sent to hospital and nineteen have not returned. Eleven of the nineteen were of the shin-pain type.

There were twenty known recurrences and eighteen of these were in men with shin-pains. The other two were cases with general muscular pains.

The distribution of the cases is again of interest.

There were 15 shin-pain cases in D Company, 6 had recurrences. In A Company there were 25 cases and 20 of these were in 2 platoons.

Headquarters Company was again attacked but on this occasion the infection was less severe except in the case of the sick corporal.

On the 3rd one of the H. Q. orderlies was sent to hospital with pyrexia and pains in his legs. The pains seemed rather in the muscles than in the bones.

On the 10th another orderly followed him, and on the 13th the sick corporal was attacked. He had very severe shin-pains and has had three relapses. On the 20th one of the observers went sick, and on the 26th another orderly. On the 31st yet another orderly was attacked. All

the men except my sick corporal recovered rapidly, and in none of them did shin-pains cause much complaint.

An interesting fact was that three days after my sick corporal was attacked his greatest friend, C. S. M., of A Company, was seized with an exactly similar illness. He had severe shin-pains and had two relapses. These two men were constantly together and their simultaneous infection seems more than a coincidence.

In November we were off and on in trenches all month. There was a good deal of rain and some trenches were much waterlogged.

There were 62 cases of P.U.O. of these 21 have been shin-pain cases. A point of interest is that of the 21 men with shin-pains 15, or 75 per cent, are men who have suffered in the same way during spring and summer. That is to say that during November there were only 6 fresh cases of the shin-pain type.

Of the forty-one men without shin-pains all except two were men complaining of general muscular pains and slight coughs, in fact what one before the war would have called influenza.

Thirty-four men have been sent into hospital with this general muscular type of illness and most of them have returned. There have been no recurrences.

Such are the facts of my experiences of P.U.O. during fifteen months in France and Belgium. I realize very clearly the many deficiencies of my clinical records, but the possibility of following the histories of many cases for several months, sometimes a year or longer, lends a certain value to them.

The points which seem of interest are these :—

First.—The Battalion came to France in very hot weather. Their sanitary zeal was slight and flies were very prevalent. In spite of this there was no outbreak of any form of pyrexial illness. There were sporadic cases, of what are for want of a better name called influenza. The symptoms consisted of general muscular pains with often a slight cough. During the winter months, although the weather was bad, trenches were wet and men hard-worked, the health of the battalion was good. Such cases of pyrexia that occurred and showed no definite cause were all of the general muscular type.

Second.—At the end of February the battalion moved and was in the back area till March — when it took over a new line at Z—. The trenches were good and dry but the sanitary condition of the neighbourhood was bad. The weather was much warmer towards the end of the month. Flies appeared in numbers. In the first half of April the men were in trenches and there were six cases of pyrexia with general pains. In the last half of the month the men were in rest and there were 16 cases of pyrexia, 8 with general pains but 8 complaining of a condition I had not heard of till then in the unit, namely, severe pains in the shins. The pains were so severe as to suggest to me the lightning pains of tabes. About the end of April our only diagnosed cases of paratyphoid occurred.

Third.—These cases of shin-pains became increasingly common and another characteristic, their tendency to relapse, was noticed. It was also noticed that they tended to occur in groups amongst men who were much together. They also came in waves as regards time. For a fortnight there might be only 1 or 2 and then in the following week there might be 20. Whether the men were in or out of trenches seemed to make no difference. All during the summer and autumn these cases occurred, reaching a maximum in October, when they caused a morbidity of nine per cent. The unit was very actively employed in July and September; shortly after each period of increased activity there was an outbreak of this type of illness. It was not possible to definitely fix the period. The infectivity of the condition was very strongly suggested by certain cases. Actual trench conditions were experienced for the first time by our H. Q. Company during July. At the beginning of August the first case of shin-pain illness occurred in this company. There were five subsequent ones chiefly in the signal section. Through the whole period cases of general muscular pain associated often with cough and headache occurred with varying frequency; as a rule when the shin-pain cases are most frequent so are the others. A few general muscular pain cases developed pains in their shins and had relapses.

Fourth.—After the end of October the shin-pain cases almost disappeared. In October the morbidity from such cases was 90 per 1,000; in November it was 10 per 1,000.

The general muscular cases often with coughs increased during November by more than 100 per cent. In October there were thirty-two such cases in the unit and in November there were sixty-nine. The records for December show an exactly similar state of things, namely, the practical disappearance of shin-pain cases and a steady flow of cases with general pains and more or less marked naso-pharyngeal symptoms.

That cases of pyrexia, often recurrent, associated with pains generally confined to the tibiæ and worse at night, do occur amongst the troops of the Western Front is I think established. There has been some literature on the subject of varying value. The tendency has been to group all pyrexias together, when the cause of the pyrexia was not obvious, and to call them "trench fever." There is no doubt that many real naso-pharyngeal infections with organisms of the catarrhal group have quite undeservedly gained this imposing title. I am certain that the majority of my cases with general muscular pains and slight coughs were really such infections. As everyone knows, a Friedländer infection or a *B. influenzae* infection can cause much general discomfort with few local signs. These cases have been in my experience exactly what is called an influenza cold or "a chill" in general practice.

The shin-pain cases are quite different both in symptoms and course. This seems fairly generally accepted.

There has been a good deal of literature regarding these cases. In the *British Medical Journal* for February 12, 1916, Captain J. W.

McNee describes such pyrexias as seen in a C.C.S. In the same journal for November 11, 1916, Captain Muir gives the field ambulance point of view. In the number of November 25 there is the gist of a meeting of the Hamburg Medical Society, giving extracts from the chief German and Austrian medical papers dealing with the same subject.

Everyone seems pretty well agreed as to the salient characteristics of the disease, namely, pyrexia coming on suddenly with pains in the bones, especially the tibia, which pains are sometimes very severe. The tendency of the pyrexia to recur after several days of normal temperature and freedom from pain is also mentioned by all the writers. The Germans say that in every case the X-rays have confirmed the diagnosis of periostitis. On the other hand I have the word of a British Medical Officer who has recently joined this Division from a base hospital and he assures me that skilled radiologists have examined many cases and found absolutely nothing abnormal. All I can say is that very often the tenderness seemed to be a short distance to the outer side of the tibia.

Then again there has been a discusssion as to whether these cases might be a form of infective neuritis chiefly affecting the legs. This is possible but in no case have I detected any tenderness along the nerve trunks, and muscular wasting does not occur. It is also hard to imagine a neuritis that could disappear in a day and return with increased severity within a week. Certainly the increase of pain at night and its relief by heat are what one does find in cases of definite neuritis.

Yet another theory regards these cases as malarial. Acute pains in the legs are a not uncommon accompaniment of some malarial infections. The absence of the disease, as far as my experience goes, during cold weather, would also support this theory to some extent.

General ——— was desirous of trying the effect of quinine on these cases and I put a platoon on six grains a day. Unfortunately the disease was decreasing at the time and there have been very few cases in the battalion since it was started. It has not therefore had a fair trial, but it is undoubtedly worth trying and I intend to make some further observations on its effect.

The puttee theory is another attempted explanation of the condition.

It asserts that the constant pressure of puttees, especially if wet, so acts on the nutrition of the lower leg as to cause a type of chronic infection. The whole symptoms of the disease, however, are those of a general infection and not a local inflammation. This theory would also fail to explain the recurrence of pyrexia and shin-pains in men lying in bed with no puttees on.

An organism which would cause the condition is equally unknown. There are some, I think a decreasing number, who regard all cases of pyrexia of doubtful origin as due to an enteric group organism. The occurrence of these shin-pain cases chiefly during the spring and summer months would at any rate lend some support to the theory that the infection is insect borne. There is however no evidence to suggest that

the infection is of the enteric group. In the first place the bacteriologists of the Army have worked unremittingly to find such an organism in these cases without success. I think that everyone will agree that such testimony practically excludes the possibility of this type of infection being the cause of these cases.

My own experience goes to show that full inoculation with T.A.B. is no protection at all against this condition. As I said before, half the battalion was inoculated fully with $\frac{\text{T.A.B.}}{2}$ at the end of April. In the shin-pain recurrent cases of July, August and September, which were thirty-one, sixteen were so inoculated.

This impartiality of the shin-pain organism in attacking those inoculated and those uninoculated with $\frac{\text{T.A.B.}}{2}$ seems to me to put the theory of its being a paratyphoid A or B organism quite out of court.

Another point against this theory is the fact that men can get second attacks of this illness. No typhoid or paratyphoid organism behaves in this way.

Another theory is that this illness is a disease of exhaustion or of wet trenches. As a matter of fact, when our men were in the wettest place and had the hardest work, namely, last winter in X—, there was none of this kind of infection at all.

Rats and lice have been said to carry it. The X— trenches were full of rats and a year ago last month (November, 1915) 300 men in the battalion were definitely lousy.

This paper is really meant to be suggestive only. I state the facts as I have seen them but am very unwilling to draw any very definite conclusions.

All one can say is that here is an illness with certain definite and unusual symptoms. It appears to be infectious but not very greatly so. The evidence seems to me to put typhoid and paratyphoid infections out of court. It seems to prefer the summer for its appearance. It is to be observed in Captain Muir's paper that his cases increased in spring and summer. He blamed the cold, and excessive exhaustion. The Germans write about this illness in June and July and describe it also as occurring in autumn. The occurrence in summer makes one suspect that it may be a fly-borne disease.

The fact that at X— we did not have a case of this illness and that as soon as we moved to Z— it commenced, makes one think that possibly the disease may be endemic. Another thing that is common at the one place and not at the other is the number of unburied bodies. The question arises whether that might have anything to do with the disease.

Altogether there are many very interesting questions still to be answered, and I think you will agree with me that their ultimate decision lies with one man, namely, the bacteriologist.

CLINICAL OBSERVATIONS ON ONE HUNDRED CASES OF "TRENCH" NEPHRITIS.¹

BY CAPTAIN S. C. DYKE.

Royal Army Medical Corps.

THE 100 cases from which this report is compiled were all seen at a General Hospital in France, in wards especially set aside for the reception of nephritic patients. The actual period of observation extended from early in January until late in February, 1917; the dates of onset in the cases considered varying from late in November to late in February. During the first few weeks of this period—that is, throughout the latter part of November and the whole of December, 1916—the weather was such as is usual in Northern France at the season—moderately cold, damp and sunless. From then onwards was a period of intense cold with northerly winds, snow, and a high proportion of bright clear days. The majority of the patients taken ill during the earlier period had suffered from exposure to cold and wet; during the latter the degree of cold was greatly increased, but the element of damp was largely eliminated by the continuous frost. With the exception of two cases, in which the kidney symptoms were discovered after admission to hospital, they all came down from the Casualty Clearing Stations with diagnoses of nephritis, acute nephritis or albuminuria. They varied greatly in severity from cases showing very marked signs of kidney trouble of a serious nature down to patients in whom the only symptom was the presence of albumin in the urine.

The cases at the two ends of the scale of gravity shaded so imperceptibly into each other that it was found impossible to make any line of demarcation, having on the one side those showing a morbid and on the other those with a possibly abnormal, but not necessarily pathological, condition of the kidney. No sharp line could be established between what were obviously that condition which one is accustomed to call acute nephritis, on the one hand, and on the other the cases which one might have been tempted to describe as "functional" or "postural" albuminuria. All seemed to be indications of an affection of the kidney differing in degree only.

The series included cases from many formations. The percentages were: Infantry 80; R.E.'s 8; R.F.A. 5; A.S.C. 4; R.G.A. 1; R.A.M.C. 1; R.F.C. 1. The formations in question were all actually in the field—that is to say none of them were stationed at bases or on the lines of communication, and consequently even when not actually "in the trenches" the men had been subjected to considerable exposure. The one patient from the R.F.C. was attached to a kite balloon section on the Somme and had been living in roughly made shelters.

¹ Received for publication May 25, 1917.

Age.—The incidence in regard to age is spread with a rather striking evenness over the five-yearly periods between 20 and 40. The vast majority of the British soldiers in France fall between these ages, and it is not surprising that only one case occurred below 20, the age of this patient being 19. Considering, however, how comparatively few men of 41 or over are on active service in France it is rather suggestive that eight per cent of the cases fall into this category. The ages of incidence for the remaining ninety-one cases were as follows:—

Age 20 to 25	..	..	23 cases.
„ 26 to 30	..	..	21 „
„ 31 to 35	..	..	23 „
„ 36 to 40	..	..	24 „

There are probably considerably more men in the British Expeditionary Force in France between the ages of 20 and 30 than between 31 and 40, and it is certainly worthy of note that the number of cases in the former group was only forty-four as compared to forty-seven between the latter ages. There are, moreover, certainly fewer men in the field between 36 and 40 than between 20 and 25, and the fact that the figures for these two series are almost identical, 24 as compared to 23, points to the same conclusion—namely, that the liability to the malady increases with age.

Service in the Field.—A consideration of the time of service with the British Expeditionary Force brings out no very striking fact, save that twenty-one per cent of the cases had been in France for over one year. Three patients had been in France for only one month, but no period under that was recorded. The service in France of the remainder was as follows:—

1 to 3 months	..	..	23 cases.
3 to 6 „	..	..	28 „
6 to 12 „	..	..	25 „

Past History.—Investigation into the past history of the cases revealed a comparatively high incidence of acute rheumatism, a history of this disease being obtained in eleven. That the disease actually was acute rheumatism was ascertained as nearly as possible by enquiry as to symptoms remembered by the patient and length of stay in bed. Next to acute rheumatism came scarlet fever with an incidence of ten, in two cases with a definite history of consequent kidney trouble. Including these two cases acute kidney trouble occurred five times in all; in four other cases there was a history of swelling of the face and feet in the past of unknown causation, but probably associated with renal disorder. Of the other exanthemata measles occurred twice and diphtheria twice.

Onset.—The onset in the great majority, eighty-five of the cases, was gradual. In the remaining fifteen the patient up to that time feeling comparatively well—as well as men expect to feel in the trenches in winter time—was taken ill so suddenly and violently as to be forced there and then to give up his work and go sick. Of these cases of sudden onset the first symptom in five was dyspnoea, in another five œdema coming on

suddenly during sleep. Two patients reported sudden and severe headache, in one case associated with vomiting; in one case præcordial pain was the immediate cause of reporting sick, while one patient admitted unconscious could remember nothing from the time of his disembarking from the leave boat.

Symptoms.—*Œdema.* Œdema described by the patients themselves as "swelling" was the most frequent symptom of all. In twenty-two this was the first thing noticed; in sixty-eight it came on later; in a few cases not being noticed until the patient was actually in the Field Ambulance or Casualty Clearing Station. In only ten of the cases could no history of œdema be obtained.

In four cases it was curiously localized. In one of these on arrival in hospital the patient showed, with a slight general anasarca, a great enlargement of the right leg with little of the left; in this case no sore or other cause could be found to account for this difference. In a second case in which there was swelling of the left leg but none of the right, a small ulcer was present in the popliteal space on the affected side. This appeared before the swelling and healed in advance of the disappearance of the œdema. In a third case an œdema confined to one side of the face was associated with septic teeth on that side of the jaw. In the fourth case the immediate cause of the patient's being evacuated from his unit was an intense œdema of the scalp and forehead. A note accompanied this patient from the C.C.S. to the effect that the swelling resembled a cellulitis, but that no septic focus could be found. All these four cases showed albumin, casts and blood in the urine. In the remaining cases the œdema was most frequently noticed by the patients in the face and backs of the hands. The thighs and knees were often reported as having been swollen—the legs less frequently so—this probably being due to the constriction of the puttees. In hospital the œdema was found to persist longest in the back and below the malleoli.

Other Symptoms.—The next commonest symptom was headache, which was complained of by fifty-nine. Of the more typical symptoms the most frequent was dyspnœa in forty-seven. Cough, often very severe, was present in thirty-six cases. Coryza was present in 16, hoarseness or loss of voice, presumably due to laryngitis, in 5, and sore throat in 5.

Early symptoms possibly referable to the urinary system were as follows: Pain in the loins in 39 cases; painful micturition in 7; frequent micturition 7; incontinence of urine 1. In three cases a diminution of the amount of urine passed was reported.

Vomiting was present at the onset in fifteen, and diarrhœa in four cases.

Apart from the pain in the loins referred to above, pain in other parts was also a prominent feature at the onset. A general aching, similar to that experienced in influenza, was described in 8 cases, in 16 it was localized in the legs, in 13 apparently in the muscles and in 3 in the shins. These last three cases were interesting as the pain and tenderness

was similar to that present in "trench fever," and like it was associated with pain in the back. Pyrexia was present in these three cases for some time after the onset. It seems possible that there was here an intercurrent infection of the type known as "trench fever." Epigastric pain was present in six and præcordial in three cases.

Epistaxis was reported in three cases. In five subconjunctival hæmorrhages were present. In two cases these were a very marked feature—in one the whole visible surface of the sclerotic was hæmorrhagic, while in the other the discoloration was sharply confined to the outer half of each eye.

Shivering (? rigor) was present at the onset in five cases.

Pyrexia.—The earliest that any of these cases were seen was on the third day from the onset, while many were not seen until the tenth day; consequently it was impossible to determine whether or not the onset was attended by pyrexia in all cases. That this was sometimes the case was shown by occasional notes on the field medical card, recording temperatures up to 103° F.

Eighteen of the 100 cases only showed any pyrexia on admission. In 6 the temperature dropped to and remained at normal within fourteen days of the onset, 5 more fell to normal within the third week, and 4 more within the fourth. The remaining three continued some degree of fever into the fifth week of the illness. It was very noticeable that the majority of these eighteen cases admitted with pyrexia showed some intercurrent affection sufficient to account for the fever. In 6 this was bronchitis, 3 more were the suspected cases of "trench fever" already mentioned, and 1 apparently a pyelitis.

A rather remarkable feature of the temperature chart was the occurrence, quite unexpectedly, and for no apparent cause of short periods of pyrexia, of from twenty-four to seventy-two hours. These were unattended by symptoms, except sometimes by headache and pain in the back. In 10 of 16 cases these occurred in the second week of the disease; in 4 in the third, and in 1 in the fourth. In one case three such minor relapses occurred in the fourth, fifth, and sixth weeks respectively.

Longer periods of pyrexia of from four to ten days after an apyrexial period occurred in seven cases, but in all these, with the possible exception of one, the causation of the fever was easily explicable. In 3 it was accompanied by severe bronchitis; in 1 by intestinal disturbances and diarrhœa; in 1 by a carbuncle on the face; and in another by marked shin pains and an apparent recurrent attack of "trench fever." The seventh case was a severe relapse, with drowsiness and marked hæmaturia, to which reference will be made later.

The conclusions arrived at in regard to pyrexia were:—

(1) That apart from the actual time of onset on which records were not obtainable, pyrexia is not usually present in the early stages, unless due to some intercurrent infection.

(2) That short pyrexial periods are liable to occur without apparent cause at any time up to the fourth week.

(3) That longer pyrexial periods occurring after an apyrexial period are always due to an intercurrent infection.

Association with Bronchitis.—The association of bronchitis with the kidney symptoms has been mentioned several times above, and, indeed, this was one of the most striking features of the series. It was actually seen, or a history of it obtained, in thirty-six cases; and it is probable that it was an early symptom in a great many more, as men in the trenches in winter get into the habit of disregarding a cough unless of unusual severity.

In four cases the bronchitis was so severe as to endanger the life of the patient, being of the purulent type, which has been so fatal in the British Expeditionary Force in France. In one of these cases pure cultures of *Bacillus catarrhalis* were obtained from the sputum; in a second of *B. influenza*. The remaining two were mixed infections, with a prevalence of the pneumococcus. These bronchitic cases were always troubled by dyspnoea, and this and the "weakness," complained of by twenty of the patients, probably accounts for the large incidence of dyspnoea found in the history of the onset.

Besides signs of bronchitis in the lungs, it was no uncommon thing in the oedematous cases to obtain signs of fluid in the pleural sac at both bases. Its presence was demonstrated by exploration in three cases. The fluid was of a clear straw colour, and free from cells of inflammatory origin.

The Heart.—The apex beat was found in the sixth intercostal space in sixteen of the cases, but in only four was there any marked enlargement. In three cases a fugitive systolic bruit, apparently not due to any organic lesion, was heard at the apex.

The Urine.—Amount: Oliguria, understood as an output of urine of less than thirty fluid ounces in the twenty-four hours, was present for anything up to three days after admission in about 15 per cent of the cases, but was apparently due more to previous diminished intake of fluid than to any lack of functional capacity on the part of the kidney. In no case was there any difficulty in establishing a good flow of urine so soon as the patient was placed on suitable diet and drinks. In two cases patients went from twelve to eighteen hours without passing water, but the urinary flow was soon re-established under hot poultices to the loins and diuretic drinks.

In those cases with a low urinary output the specific gravity was high; thus, on the first two or three days after admission a specific gravity of 1,025 to 1,038 was not uncommon. Later, with a free fluid intake, it was always observed to fall, remaining in the great majority of cases at from 1,010 to 1,012.

Very high daily outputs of urine were fairly frequent, being particularly noticeable at the commencement of the disappearance of a profound general oedema. The highest amount recorded was 193 fluid ounces in twenty-four hours.

The reaction was universally acid.

Albumin.—Albumin was present in the urine in every case except one not seen until the thirty-second day but previously diagnosed as nephritis. It disappeared while the case was under observation in twelve cases, this disappearance taking place on dates from the eighth to the thirty-fifth day of the disease. The remaining cases all went to England still showing albumin in the urine, although in every case the percentage was sensibly diminished below that with which they were admitted. In only nineteen cases were the patients evacuated with an Esbach reading of more than one gramme of albumin to the litre of urine. As the cases were first seen at all periods in the course of the disease, very varying degrees of albuminuria were met with on their admission. In some instances, notably where there was much œdema and bronchitis, the Esbach reading was extremely high. In many cases it was far above the 12 mark on the Esbach tube, in one instance the reading remained above this mark for four days after admission, even after fourfold dilution, indicating the presence of well over forty-eight grammes of albumin to the litre. There was further a tendency for sudden increases in the intensity of the albuminuria after periods of comparatively low albumin content. Such rises in the albumin output were often associated with periods of pyrexia (figs. 4, 5 and 6); in favourable uncomplicated cases the diminution in albuminuria was rapid (figs. 2 and 3.)

Casts.—Casts were found in almost every case, though often not until repeated search had been made. They were usually granular or epithelial. Hyaline casts were also fairly common. Blood casts were found twice and waxy once. The only importance attaching to the presence of casts seems to be that in very large numbers they indicate a severe degree of damage to the kidneys. In a few cases the urine on standing formed a sediment consisting almost entirely of granular casts, and these were particularly severe and obstinate cases.

Hæmaturia.—Hæmaturia was present in every case; it varied greatly in degree, however, from cases where microscopic search of centrifuged urine yielded only a few red blood cells, to those in which the presence of blood in the urine was obvious to the naked eye. Urines showing much blood macroscopically fell into two classes—those in which the specimen was of a bright cherry red, without much sediment, and those of a dark brown colour with tendency to formation of a thick brown sediment on standing. This latter type of urine was always associated with what Abercrombie has described as “lower tract” cases, that is, those showing symptoms referable to the bladder and ureters. This is not a common type of the disease, only five cases occurring in the series, but it is very striking when seen. The patient complains of severe pain in the loins—sometimes confined to one side only, of frequency of micturition, and of scalding pains during and more particularly at the end of the act. Rather more headache than was usual in the ordinary type of case was complained of in these

cases; and fairly severe vomiting was present once. The urine in addition to large quantities of blood cells always showed bladder epithelial cells, sometimes in large amount. The big cubical cells from the superficial layer of the bladder epithelium were the most commonly seen, but stalked cells from the deeper layers of the epithelium were not infrequent. The cells usually occurred singly or in clumps of two or three, but occasionally sheets of epithelium, large enough almost to cover the field of a one-sixth objective, were met with. In addition to blood and epithelial cells from the bladder, these urines also always showed considerable numbers of granular casts. The appearances seemed to point to a certain degree of infection of the bladder epithelium, but a cystoscopic examination was not made. It is to be regretted that the series had to be closed before thorough bacteriological and cytological examinations of the urines in these cases could be made, because they seem to provide a peculiarly promising field for the identification of any infecting organism or other cause of this malady.

A peculiar feature of the centrifuged urinary sediment was the almost constant presence of polymorphonuclear leucocytes. In those where the hæmaturia was intense it was naturally impossible to make out whether or no they formed an unusually large proportion of the blood cells present. Where, however, fewer red cells were present the high proportion of polymorphonuclears was often very noticeable, and it was a common thing to see specimens under the microscope in which the field of the one-sixth objective showed everywhere from six to a dozen of these cells with only an occasional erythrocyte. In only one case was pus actually present to the naked eye, and this was the case of pyelitis already referred to. The microscopic picture was here quite different, the whole field being thickly crammed with leucocytes; large leucocyte casts were also present.

Salt Content.—Estimations of the salt content of the urine by Volhard's method were made in six cases, and in every one it was found that this was low while the œdema lasted. With the disappearance of the œdema the salt content of the urine rose (fig. 7). During these estimations the patients were kept on a constant diet, low in, but not actually free from, sodium chloride. The exact amount ingested daily was not known but it was fairly constant. It had been intended to conduct some experiments on the power of excreting sodium chloride during the persistence of the œdema, but unfortunately observations had to be closed before this was done. Extra sodium chloride was fed to one case during the disappearance of the œdema and was found to be well excreted (Case 54, fig. 7).

The Blood.—Urea content: Determination of the urea in the serum or whole blood was carried out in nineteen cases. Either whole blood or serum was used as convenient, it having been found that the difference between the urea content of the two from the same case was so small as to be negligible. When whole blood was used it was laked by the addition of distilled water. The laked blood or serum was then treated with

metaphosphoric or trichloroacetic acid to eliminate the proteins, and the filtrate then treated with sodium hypobromite. The amount of nitrogen liberated was measured, the result reduced to standard temperature and pressure and then expressed in terms of urea. The method is not absolutely accurate but nearly enough so for clinical purposes.

The highest reading obtained was 1.34 grammes per litre on the fourth day from the onset, the lowest 0.46 on the twelfth day. The case giving the reading of 1.34 was one showing marked œdema and intense bronchitis without any "uræmic" symptoms, except a high-tension pulse. Readings of 1.19 on the fifth day, and of 1.25 on the seventh were obtained in two other cases similar, except that bronchitis was not present to the same degree. In a fourth case admitted unconscious, but without œdema or any other symptoms of renal trouble apart from a moderate albuminuria, a reading of 1.20 was obtained on the fifth day.

That the urea content of the blood falls rapidly with improvement was shown in this last case. On the seventh day, with considerable decrease of the mental symptoms the reading was 0.97 gramme per litre, while on the fifteenth day, when the condition except for a slight headache and a trace of albuminuria was normal, it had fallen to 0.56. In the case in which the reading was 1.25 on the seventh day it had fallen by the twelfth to 0.79.

Two cases of great severity gave readings of 0.79 and 0.66 gramme urea per litre of blood as late as the forty-seventh and fiftieth days of the disease respectively. The former was not free from œdema even at that time and the latter had only been free for a short time. Both had shown intense œdema, much hæmaturia, and were still passing casts in large quantities. The former case still showed six grammes and the latter four grammes of albumin to the litre of urine. Another similar case showed 0.77 gramme urea to the litre of blood on the twenty-sixth day. These were all cases in which the symptoms pointed to a very high degree of damage to the kidney, and the high urea readings of the blood at comparatively late dates in the course of the disease merely served to confirm the general bad prognosis.

Other readings obtained were:—

0.76 gramme urea to the litre blood on the 12th day.

0.75	"	"	"	"	"	"	4th	"
0.62	"	"	"	"	"	"	2nd	"
0.61	"	"	"	"	"	"	13th	"
0.61	"	"	"	"	"	"	13th	"
0.61	"	"	"	"	"	"	4th	"
0.60	"	"	"	"	"	"	31st	"
0.58	"	"	"	"	"	"	7th	"
0.57	"	"	"	"	"	"	10th	"
0.53	"	"	"	"	"	"	10th	"
0.50	"	"	"	"	"	"	8th	"
0.46	"	"	"	"	"	"	12th	"

Acidity.—With a view to ascertaining if the dyspnoea present in so many cases was attributable to an increased acidity of the blood, determinations of the degree of acidity were made in eight cases by Captain Wolf, R.A.M.C. These cases all showed a certain degree of dyspnoea associated in every case with some bronchitis. In only one was any increase in the hydrogen ion concentration found. This was the most markedly dyspnoeic of all the cases and bronchitis of some severity was present. The acidity reported here was p. H. '83, corresponding to thirty-five millimetres of alveolar CO₂. In all the other cases the reading was p. H. '85.

Uræmia.—Actual "uræmic" symptoms were only seen in one case in the series. This patient was admitted unconscious from another hospital; he was apparently taken ill with great suddenness, for no history could be obtained from him, except that the last thing he remembered was disembarking from the leave boat, at which time he felt quite well. No oedema was to be seen in this case, albumin was present to the extent of only '05 per cent in the urine; no convulsions were observed. The patient slowly regained consciousness. Within a week of the onset he was perfectly rational and complained of nothing more than a slight headache. The findings of the amount of urea in the blood in this case have already been given.

The occurrence of "convulsions" was noted on the field medical cards of four of the cases. These patients were all admitted with oedema and albuminuria of varying degrees. Three of them cleared up with rather more than usual rapidity; the fourth was more resistant, but was ultimately evacuated free from oedema and with only '03 per cent of albumin in the urine. It is inferred that the occurrence of convulsive fits early in the disease is not an event of grave prognostic import.

As compared with the experience of others who have had charge of nephritic patients in this War, the incidence of "uræmic" symptoms in this series seems to have been unusually low. This was probably principally due to chance, but it may also have been partly due to the fact that a careful watch was kept for such symptoms of approaching uræmia as intense headache, drowsiness, increased blood-pressure, and diminution of urine. On the appearance of such symptoms recourse was at once had to blood-letting to the extent of from fifteen to twenty-five fluid ounces.

Treatment.—Treatment centred mainly around the provision of a favourable environment and suitable diet for the patients. Throughout the period of observation all patients were kept in bed between blankets, but they were permitted to sit up in bed when they felt so inclined. While the acute symptoms lasted it was found that there was no tendency to do anything but lie quietly—and this even though on inquiry no complaint of pain or discomfort was made. An inclination to sit up and read or talk with other patients was usually the sign of the approach of convalescence.

In no case did untoward symptoms result from this general freedom, and that this was so was probably due to the fact that the wards were kept as nearly as possible at a uniform temperature of about 62° F., and free from draughts. The importance of the provision of a warm equable temperature for these patients cannot be too strongly insisted upon. It is more than probable that the relapses and sudden "uræmic" attacks which have been described as occurring with nephritis cases treated in general wards are solely due to chills acquired as a result of insufficient or irregular heating. The almost complete absence of such accidents in the present series was undoubtedly largely due to the success of the nursing staff in keeping the wards day and night at an almost constant temperature.

Three main diets were used in the wards—No. 1 consisting of cow's milk when procurable, or in lieu of it Glaxo or evaporated milk. No. 2, the same as No. 1, with the addition of one and a half slices of bread and butter and rice milk, and No. 3, comprising all of the above with the addition of milk puddings, custards and vegetables, excepting peas, beans, and lentils. Cases on No. 2 and No. 3 diets were allowed weak tea, coffee, and cocoa, and were encouraged to take as much sugar and butter as they wished. It was not found practicable to exclude the salt used in cooking the food, but no additional salt was allowed.

All cases on admission were placed on No. 1 diet; in the absence of much œdema or other severe symptoms they were soon put on to No. 2. In any event no case was kept on No. 1 diet for longer than ten days together. With the disappearance of the œdema and the reduction of albuminuria to below .25 per cent they were moved on to No. 3 diet.

It has been suggested that the fluid, or solid nature of the diet, is of more importance than its chemical constitution. With a view to deciding this point, a series of similar cases were kept on Nos. 1 and 2 diets, but no difference in their course was noticed. Similarly, a series of six cases, all running from 1.0 to 0.08 per cent of albumin in the urine, were placed half on No. 3 diet only, and half on a daily portion of chicken in addition. At the end of a week, of the three cases on the chicken, one suffered from a severe relapse, with temperature running up to 103° C., hæmaturia and uræmic symptoms—the only relapse seen in the series; the second showed a rise of the albumin to 0.12 per cent, while the third suffered from drowsiness and headache, passing off on a return to the simple No. 3 diet. This was taken as an indication for care in raising the protein content of the diet too early.

Barley water and imperial drink were freely given to all cases except those with persistent œdema. Patients were not made to drink any set amount, but were encouraged to drink as often as they felt inclined to do so. Where the œdema persisted beyond the third week, the patients were not allowed to drink between meals, and were encouraged to take as little fluid as they could manage without inconvenience with meals. Under this regime the œdema in ten out of twelve obstinate cases disappeared.

Packs.—Hot packs were given as a daily routine to all cases with oedema. The packs were given with hot-water bottles, six to a case, and seldom failed to produce an intense diaphoresis. In those cases where the reaction was not good, pilocarpine $\frac{1}{10}$ to $\frac{1}{8}$ grain was given subcutaneously, but it was seldom necessary to have recourse to this measure. Pilocarpine was never given to bronchitic or dyspnoëic cases, and no evil results were seen following its use.

Venesection.—The experience gained in this series seems to show that by far the most useful therapeutic measure was free blood-letting. This was practised to the extent of from ten to twenty-five fluid ounces, and was found most efficacious in relieving headache and dyspnoea. Its use in connection with threatened uræmia has been referred to above. The median basilic vein was usually chosen, and the blood withdrawn either through an open incision or by means of a cannula.

Drugs.—Of drugs citrates, acetates and carbonates were exhibited in various combinations. For the "lower tract" cases a mixture containing sodium bicarbonate, urotropine, and tincture of hyoscyamus, was found very useful. This never failed to relieve the most troublesome symptoms, such as pain in the loins and scalding micturition, but had no effect on the hæmaturia accompanying these cases. Tr. ferri perchlor., in combination with liq. ammon. acetat., was given to combat the anæmia which often appeared late in the course of the disease.

Bronchitic Cases.—The only cases presenting any difficulties in management were those complicated by severe bronchitis. Before the subsidence of the bronchitis, these patients were often reduced to an extreme degree of debility.

A diet of a more stimulating nature than that permitted to the uncomplicated cases was allowed to these patients. A raw egg beaten up in a pint of milk was given daily; small portions of chicken were allowed on every second or third day, and the patients were plied with oatmeal gruel and arrowroot. In spite of the raised protein content of this diet, no harm was seen to result from it. Whisky or brandy, to the extent of two fluid ounces daily, was also occasionally administered without harmful results. These cases took all the ordinary expectorant and stimulant drugs well. Digitalis to the extent of one fluid dram of the tincture daily was given over considerable periods, and with none but beneficial results.

Mortality.—No deaths occurred in the series during the period of observation.

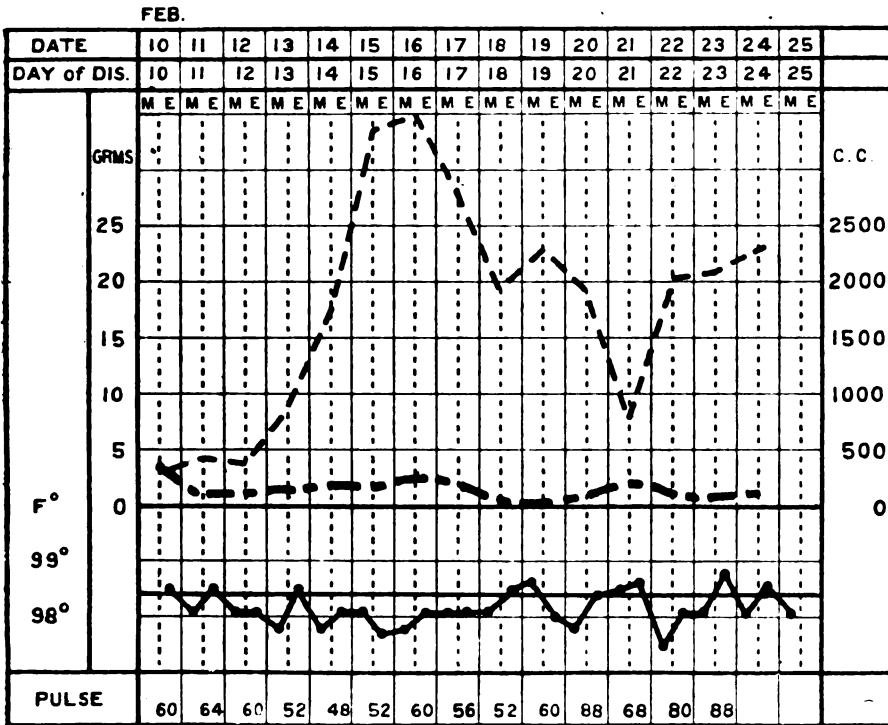


FIG. 1.—Apyrexial case.

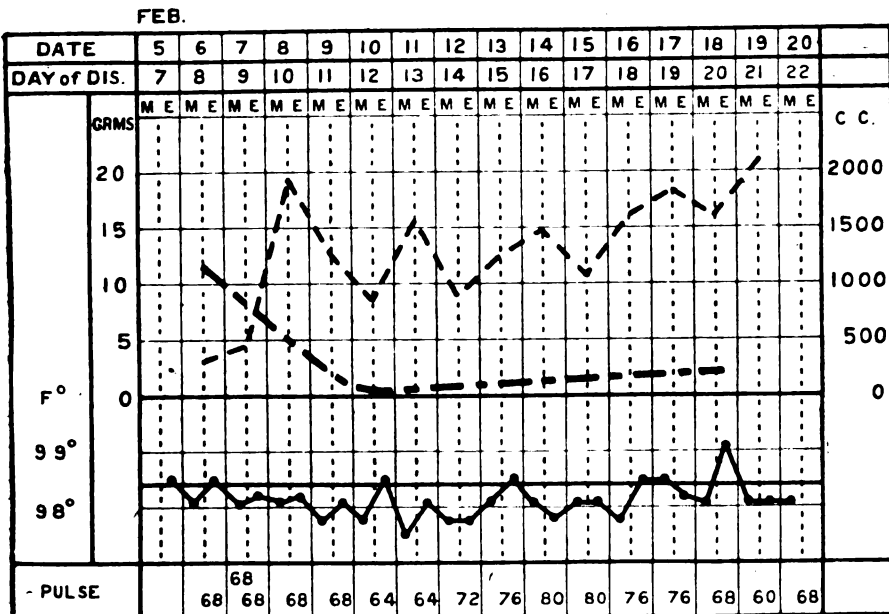


FIG. 2.—Apyrexial case.

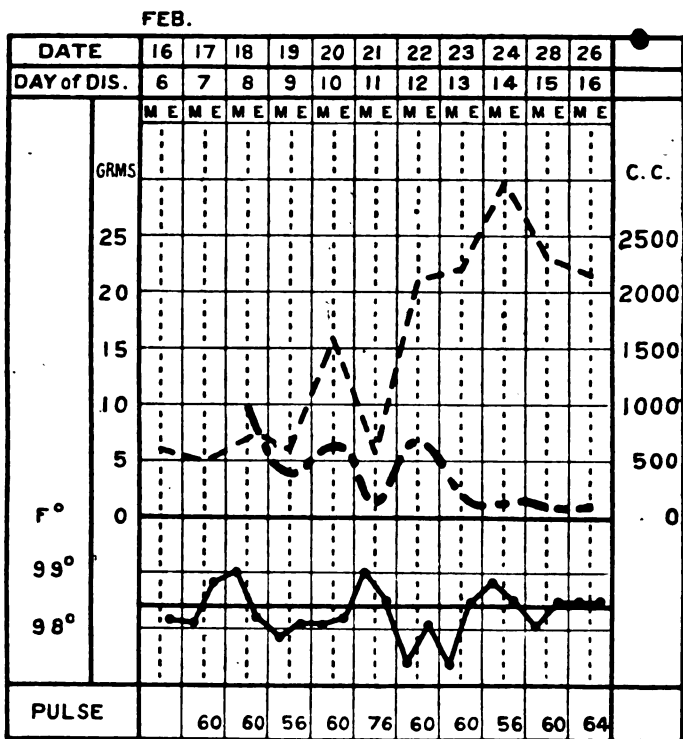


FIG. 3.—Case with slight pyrexia.

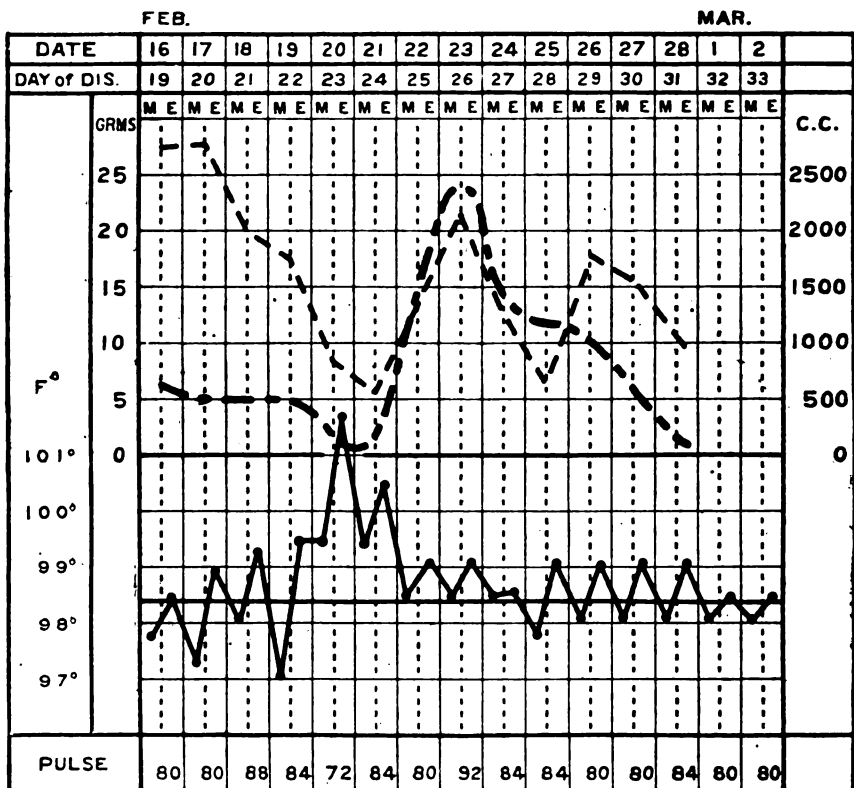


FIG. 4.—Pyrexia of short duration and of unknown causation.

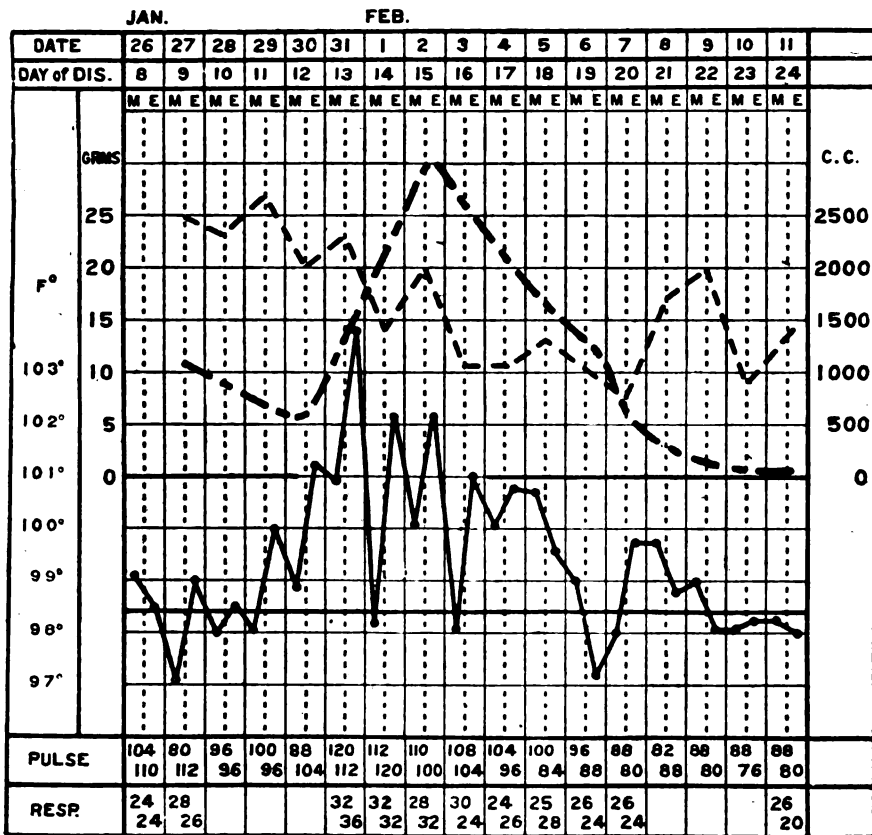


FIG. 5.—Pyrexia due to severe purulent bronchitis.

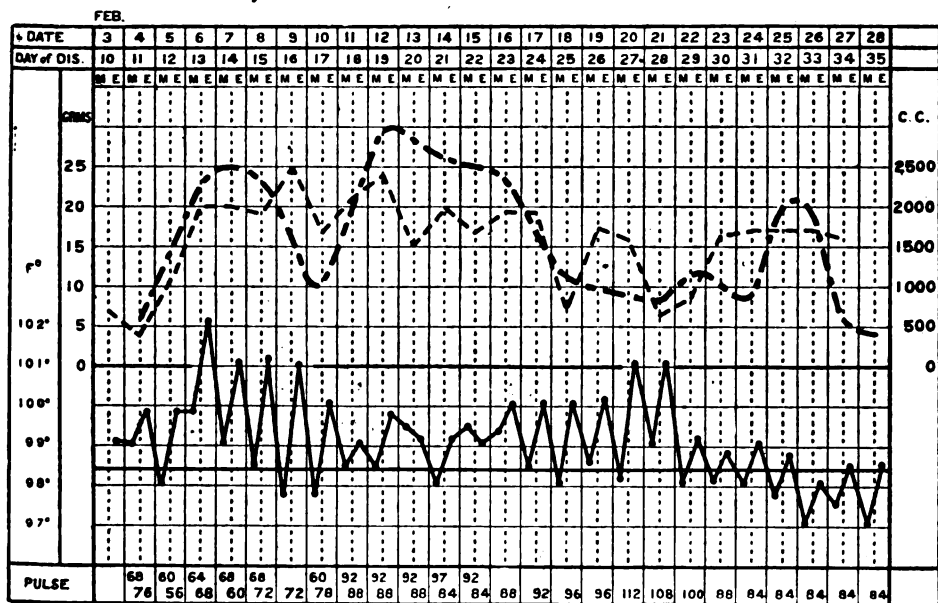


FIG. 6.—Continued pyrexia without bronchitis.

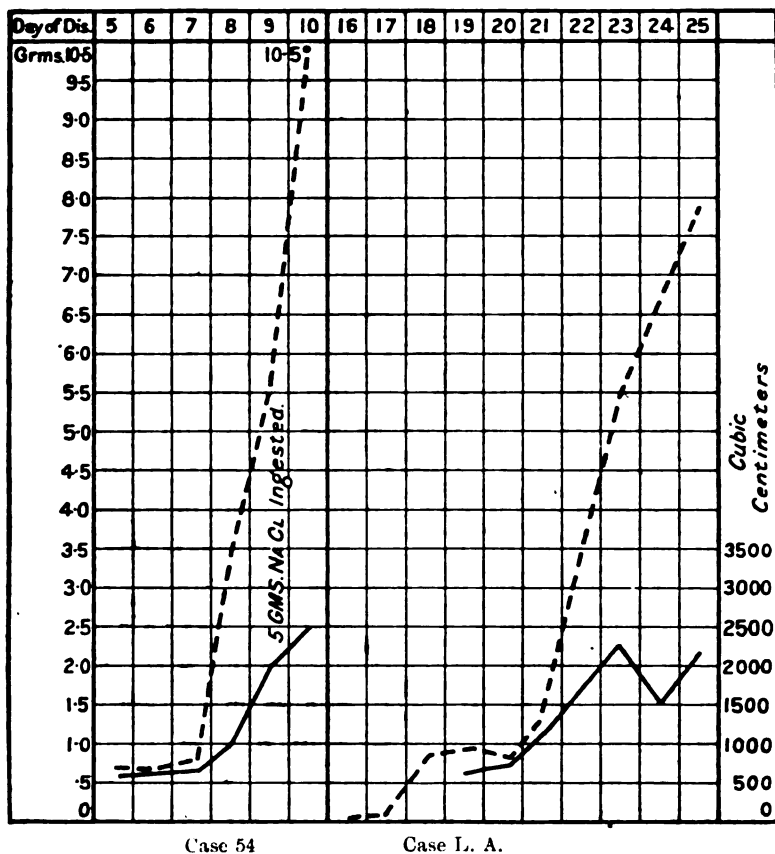


FIG. 7.

FIGS. 1 TO 6.

Charts showing daily temperature, degree of albuminuria, and excretion of urine.

Thick broken line represents amount of albumin excreted daily, expressed in grammes. It is constructed from Esbach tube readings, and is to be regarded as only approximate. To be read by the scale to left of the sheet.

Thin unbroken line represents daily excretion of urine in cubic centimetres; to be read by scale to right of the sheet.

FIG. 7.

Excretion of sodium chloride.

Broken line represents daily excretion of sodium chloride expressed in grammes; to be read by scale to left of sheet.

Unbroken line represents daily excretion of urine expressed in cubic centimetres; to be read by scale to right of sheet.

Clinical and other Notes.

THE AFTER-HISTORY OF WAR NEPHRITIS: WAR NEPHRITICS INVALIDED TO ENGLAND.

BY CAPTAIN A. ROCKE ROBINSON.

Officer in Charge Medical Division.

CAPTAIN A. G. FLEMING.

Officer in Charge Laboratories.

CAPTAIN JOHN C. CALHOUN.

Officer in Charge Eye, Ear, Nose, and Throat.

AND

CAPTAIN RUGGLES GEORGE

Officer in Charge Nephritic Ward.

Canadian Army Medical Corps,

The Duchess of Connaught Canadian Red Cross Hospital, Cliveden, Taplow, Bucks.

THERE have been published a number of excellent papers upon war or trench nephritis as it occurs in France, but the question of what eventually becomes of the patients has not been clearly worked out. The condition is usually regarded as a comparatively mild form of acute nephritis, and it is probably true that the majority of cases occurring in France and Flanders recover sufficiently in rest camps or field ambulances to permit of their return to the line. A minority of cases, those in which there is pronounced dyspnoea or extensive œdema, find their way into base hospitals in France, and here they are treated until these symptoms have abated or disappeared, and then are returned to England for further treatment. Of these a few are already free from albumin, casts, and blood, but by far the greater number still afford traces of these pathological elements in the urine.

The present investigation was commenced by Captains J. D. Bruce and A. R. Robertson in the latter part of November, 1916, when a special ward for nephritis was opened. Captain Bruce, unfortunately, left shortly afterwards, and the work was then carried on by the writers, with the purpose of ascertaining the after history of these cases.

To Captain Bruce, and also to Colonel Rudolf, our thanks are due for many helpful suggestions.

While it is true that the mortality in acute stages is practically nil (any death that has occurred among such seeming almost always to have been due, not to a primary condition, but to exacerbations of an old nephritis), it is evident from observations here recorded that the great majority of patients, ill enough to be sent to England, are still far from well at the end of three months. It is now necessary, we would suggest, that a further study be made of the condition of this class of patients at the end of, say, six months and of a year.

We have been able to investigate a considerable number of these cases, and for the purpose of this communication have subjected fifty to a detailed study—after a lapse of from two to three months or more from the onset. We have tried, by

careful questioning as to the exact mode of onset and subsequent course in France, to ascertain what manner of case it is that fails to clear up quickly, and tends to lapse into a subacute or chronic condition; this has revealed some interesting facts.

In our 50 cases we find that the average period of service in France was five and a half months, that 43 had done duty in the front line—either in trenches or gun positions—and that 7 were never at any time in the front line,¹ but were on duty either at a base or only as far as a railhead. As to past illnesses, 9 had had scarlatina in childhood, followed in one instance by severe nephritis; 13 had had measles, with no serious sequelæ; 5 had had pneumonia and 5 rheumatic fever. In three cases there was a clear history of syphilis, which in two patients seems to have had some bearing upon their present condition.

All claimed to have been in perfect health upon arrival in France. All ate the same food, and, with the exception of three, who admitted having drunk trench water when other was not obtainable, stated that they had used only the water that was served out. It is, however, entirely probable that most soldiers at some time use trench or shell-hole water.

The most frequent initial symptom was acute catarrh of some part of the respiratory tract—trachæo-bronchitis in 27, coryza in 23, and "sore throat" in 17. Rarely the entire tract was involved. Accompanying this, but usually following a short time after, was weakness and malaise in forty-four, and chills in twenty-five cases. Some degree of fever was probably present in all cases, but from the patient's own statement a history was obtainable only in twelve. Following this came dyspnœa in forty-seven cases—in forty of which it occurred in bed. Dyspnœa was also a fairly frequent first symptom. Then came œdema of varying degree in forty-nine cases, occasionally only as a slight swelling under the eyes, or of the feet. In order of onset, œdema first occurred in the face and under the eyes, then in feet and hands. Accompanying, or often preceding the œdema, was headache of varying intensity in 37 cases—of post-ocular or supra-orbital character in 25, and occipital in 3. In twenty-nine the headache was dull and constant; in nine it was sharp and lancinating. The commonest pain elsewhere was across the small of the back in 40 cases; in the muscles of the legs in 32; abdominal pains were not infrequent, usually epigastric, and of a cramping character in 16; in 13 there were joint pains, and in 19 pains in the long bones. Nausea and vomiting were present in twenty-six cases. Vertigo in thirty-one cases was also quite frequently an initial symptom. Other symptoms that frequently followed were: loss of weight in 25; insomnia in 37; anorexia in 15; diarrhœa in 9; constipation in 11; profuse sweats in 18; dryness of skin in 12; mental torpidity in 10; convulsions in 3, and partial or complete unconsciousness in 5. Visual disturbances occurred in eighteen, in one of which there was complete blindness, except for perception of light, over a period of about two weeks. Blurring of vision was the commonest occurrence, and usually came on with the onset of œdema of the orbital tissues. Objects could be seen, but their outline would be indistinct—as would be the case in errors of refraction. In one case the patient volunteered the information that, whereas in good health he had always had to use glasses for reading, he was able to read quite easily during the time that orbital œdema was marked. It seems possible that a change either in intra- or extra-ocular pressure,

¹ Hence our preference for the term, "War Nephritis," rather than "Trench Nephritis."

due to œdema of the eye or the orbital tissues temporarily altered the refraction of the eye.

The ocular changes that may have been present during the acute phase of our cases were probably those that have been commonly noted in France—œdema of the retina and the disk, phenomena which were occasionally noted in those that entered with œdema, or those in which œdema subsequently reappeared.

The commonest complaint upon entering this hospital was dull frontal headache, usually present upon awakening in the morning, and passing off towards midday. Accompanying this were pains across the loins, deep-seated, dull, sometimes unilateral, but usually bilateral, and occasionally radiating downwards towards the pelvis. It was not observed that the degree of pain bore any relationship to small fluctuations in the amount of albumin and blood (usually small) present in the urine. Dyspnœa, on exertion, has been a constant subjective symptom in all cases, with one exception. That this is often real is amply borne out by the fact that some of the patients doing light duties in the ward become dyspnœic very quickly. In a few cases a transient dyspnœa would cause the patient to "start" with a smothering sensation out of a deep sleep; such nocturnal attacks have, though, been both rare and transient. However, the fact remains that the dyspnœa is, even after two or three months from the onset of the malady, such a constant subjective symptom that we have been endeavouring to ascertain to what extent this subjective symptom is confirmed by means of physical exercise tests. We have selected only those cases in which "shortness of breath" on exertion was a voluntary statement on the part of the patient, in no wise elicited by questioning. The patient was told that the physical exercise tests were of the nature of "pulse tests." Sufficient observations have not as yet been made from which to draw definite conclusions, yet we feel fairly sure that much of the dyspnœa in patients who have been free of œdema and high blood-pressure for some weeks, with urine almost or entirely free of albumin and blood, is psychic or functional in character. It is well known that after recovery from nerve paralysis, following an injury, there is often a greater or lesser amount of functional disability due to the patient's own impression that he cannot now use the muscles supplied by that nerve.

In a precisely analogous way it is possible that in many of these nephritics the early pathological dyspnœa is succeeded by a purely functional dyspnœa. Our observations upon this subject will be given in a further communication.

In all cases that we have examined after a lapse of three months we have found no enlargement of the heart—even in those few cases in which there is still some increase of blood-pressure and second aortic accentuation. In twenty-five cases seen after a lapse of three months there were four which showed a constant increase of systolic blood-pressure—from 160 to 190—with accentuation of the second aortic sound. In two of these the œdema had been severe and prolonged with subsequent slight exacerbations on several occasions, the amount of albumin had been large, and there was much anæmia. A third case in a man over 40 was more the picture of chronic interstitial nephritis that probably antedated the War. The fourth was the only case in which there was severe albuminuric retinitis. His history is as follows:—

No. 7211, Pte. R. S. M., K.O.Y.L.I. Was strong as a boy; measles at 7; no scarlatina or venereal history. A dental mechanic in civil life. Went to France,

June, 1916, and while in trenches suffered for two months from itching sores on legs, the pigmented remains of which we counted to the number of fifty-one. These were regarded as impetiginous. Was put on light duty back at headquarters. Two weeks later, having lost his appetite and feeling very seedy, his face began to swell, then the hands and feet. He developed hacking cough, sore throat, and was nauseated and vomited. The abdomen then swelled, pain was severe in all muscles, the abdomen, and across the loins. Marked constipation. Previous to these latter symptoms, and while on light duty at headquarters, he had nocturnal frequency, but never noticed any change in colour of urine. The œdema lasted fifteen days, and during some part of this time the systolic blood-pressure reached 200, and he was passing a slightly diminished amount of urine. Two weeks later there was a return of œdema—almost as badly as on the first occasion. The eyesight became blurred, and a month later the oculist reported "albuminuric retinitis of both eyes. Large area of retina involved, showing large atrophic spots more or less confined to the macular regions; also some small hæmorrhagic areas. Cannot see card at twenty feet." Six weeks later there were "comparatively few recent hæmorrhagic areas—most of them, particularly in the right eye, showing large areas of atrophy and pigmentation. Vision has improved immensely." Three months after onset he was feeling much better, but was pale, slightly puffy under the eyes, and had throbbing occipital headache in the morning. Sleeps badly and is very constipated. Heart normal in size; slight accentuation of second aortic sound. Systolic blood-pressure 150; urine—twenty-four hours' amount—42 ounces, specific gravity 1017, acid, smoky, albumin 0.3 per cent, urea 1.3 per cent, chlorides normal; many hyaline and granular casts, red blood and pus cells.

In several cases there has been slight and transient return of œdema of the face, particularly under the eyes, and also of the extremities, accompanied by a feeling of lassitude, muscular pains, and deep-seated loin pains. In such cases there is usually some increase of the albumin, and often of blood in the urine. A remarkable case in which œdema of the hands has persisted in spite of all treatment, and amelioration of other symptoms, is worthy of mention:—

No. 310856 Gnr. F.B., Canadian Field Artillery, was always previously healthy. A policeman in civil life, had previously been an iron-worker. Nephritis began with vertigo upon getting up in the morning. Then he noticed nocturnal frequency, and shortly developed frontal headache, insomnia, and gnawing pains in legs and arms, especially in the bones. Upon reporting sick albuminuria was found. Œdema of moderate degree in hands and feet only. No visual disturbances. Three months later there was still slight œdema of hands and feet of a brawny character such as one sees in myxœdema. Thyroid extract over a period of two weeks had no effect.

Upon exercise the swelling increases and diminishes after resting. Heart normal in size and function; second aortic sound not accentuated; blood-pressure normal. He had only slight dyspnœa. Urine—three months after onset—about normal in amount, twenty-four hours, acid, pale, specific gravity 1015, albumin 0.05 per cent, a few granular and hyaline casts, red blood cells and pus cells.

In almost all of our cases several complete examinations of twenty-four hours' specimens of urine were made, with measurements of the "day" and "night" amounts as well. As most of the patients were up, even though under careful

instructions to pass all urine into a specimen jar, it is certain that some was lost at stool, so that the amounts which we give are only relatively accurate. The average twenty-four hour urine for all cases was 1,465 cubic centimetres; the average "day" amount being 785 cubic centimetres, and the average "night" amount 703 cubic centimetres; in nineteen cases the amount passed at night was greater than that passed during the day. The urine was clear amber in colour in all but five cases, which at some time passed "smoky" urine. In the majority of the cases the amount of albumin found was only about 0.05 per cent. The chlorides were about normal in all cases, except one in which there was a transient decrease during an attack of migraine to which the patient had been subject for many years. The urea, which averaged for all cases about 0.12 per cent, was practically normal, in consideration of the fact that all were on restricted protein diets.

In conclusion, we find that almost all cases invalided to this hospital from a base hospital in France show, after a period of three months, a trace of albumin, a few granular and hyaline casts, red-blood cells and pus. The chlorides and urea are about normal. Nocturnal micturition is present in nearly forty per cent of the cases, and there is probably a slightly greater amount passed during the night between 8 p.m. and 8 a.m. than during the day. Many still complain of dyspnoea, slight headache, pains across the lower part of the back, and a few develop slight transient return of oedema. They are usually very well nourished, and not anæmic; in fact, there is usually a striking absence of the pale countenance so common in the ordinary nephritis of civil life. The blood-pressure is usually normal, and there is no enlargement of the heart. Structural retinal changes are rare, having been seen in only one of our series.

A striking feature has been the fact that in over half of our cases there has been at the onset acute catarrh of some part of the respiratory passage, most frequently a bronchitis, which was usually regarded as simply a "cold." It seems probable that a test for albuminuria at this stage would have revealed the exact nature of the malady, which as a rule was not diagnosed until either hæmaturia or oedema came on. Therefore, it seems reasonable to expect that in a locality where this infection is known to be prevalent, if all cases reporting sick with "colds" were subjected to a simple quick test for albuminuria, many cases of early nephritis would be brought under treatment then, which otherwise would return at a later date in a condition less favourable for quick recovery and return to duty.

SIX CASES OF KALA-AZAR.

- (1) THEIR TREATMENT WITH INTRAVENOUS INJECTIONS OF TARTAR EMETIC;
- (2) NOTES ON THE EPIDEMIOLOGY.

BY MAJOR J. C. KENNEDY.
Royal Army Medical Corps.

(1) *Treatment with Tartar Emetic.*

THE following six cases of kala-azar were discovered amongst the convalescents admitted to the Enteric Convalescent Depot, Naini Tal, during 1916. They were received in the ordinary course as convalescents from P.U.O. or one of the enteric group of fevers.

The diagnosis was in each case confirmed by puncture of the spleen and

examination of the spleen juice for the Leishman-Donovan bodies. As soon as the diagnosis was confirmed tartar emetic treatment was begun. At first a 1 per cent solution was administered intravenously; subsequently a 2 per cent solution was used as being more convenient, and as recommended by Colonel Sir Leonard Rogers, to whom I am indebted for kindly giving me the benefit of his experience. The effect produced by the treatment has exceeded one's most sanguine expectations. I feel that I am justified in stating that 5 out of the 6 have been permanently cured; unfortunately, 1 died as the result of an inter-current attack of pneumonia. The essential details of each case are as follows:—

Case 1.—Cpl. A. W., "C" Company, Middlesex Regiment, aged 21. July 2, 1916: Spleen puncture, Leishmania present. Temperature in the evenings varying between 100° F. and 101° F., remitting in the mornings to normal. Liver enlarged slightly. Spleen enlarged to seven inches below costal margin in the nipple line. Red cells 5,350,000, white cells 5,480 per cubic millimetre. Weight 119 pounds. July 5: Intravenous injections of 1 per cent solution of tartar emetic begun. July 24: Attack of splenitis lasting three days with acute pain and temperature rising to 102° F. Spleen five inches below costal margin. July 28: Began using 2 per cent solution tartar emetic. August 4: Temperature now normal. Total tartar emetic administered up to date, 0.595 gramme. August 20 to 24: Developed a septic sore on the lip which spread for about one inch over the buccal mucous membrane. Fever lasted for four days and ran up to 102.4° F. Temperature is now normal and sore healing. November 2, 1916: Leucocyte count 4,800. January 3, 1917: Spleen just felt at costal margin. Weight 121 pounds. Total tartar emetic to date, 4.615 grammes. January 23: Spleen normal. March 20: Treatment stopped; total tartar emetic given, 6.515 grammes. July 2: Patient has been in perfect health ever since. Spleen normal. Leucocytes 8,600. Weight 123 pounds.

Case 2.—Lance-Cpl. L. H., "C" Company, Middlesex Regiment, aged 20. July 4, 1916: Spleen puncture. Leishmania present. Temperature of remittent type varying between 102° F. and 104° F. in the evenings and 99° F. to 101° F. in the mornings. Liver dullness 6½ inches in the nipple line. Spleen enlarged to four inches below the costal margin. Blood count, reds 6,200,000, whites 4,914 per cubic millimetre. Weight 134 pounds. July 6: Began intravenous injections of 1 per cent solution tartar emetic. July 17: Temperature normal. Total tartar emetic to date, 0.145 gramme. July 28: Injections with 2 per cent solution begun. Spleen three inches below costal margin. Since July 17, temperature has been somewhat irregular with occasional evening rises, but never above 100° F. August 11: From this date temperature remained normal. Total tartar emetic to date 0.945 grammes. September 3: Spleen only 1½ inches below costal margin. Weight 147 pounds. October 16: Leucocyte count 6,562. Spleen felt only on deep inspiration. Weight 158 pounds. Total tartar emetic to date, 2.835 grammes. December 22: Last day of treatment. Total amount of tartar emetic given, 3.645 grammes. July 2, 1917: Patient has been in perfect health ever since. Spleen normal. Leucocytes 10,000. Weight 157 pounds.

Case 3.—Pte. J. B., "C" Company, Middlesex Regiment, aged 24. July 6, 1916: Spleen puncture. Leishmania present. Temperature remittent, 101° F. in the evenings and 98° F. to 99° F. in the mornings. Spleen five inches below

costal margin. Weight 109 pounds. July 9: Began treatment with 1 per cent solution of tartar emetic. July 26: Temperature is showing no improvement. Total tartar emetic up to date, 0.215 gramme. Treatment with 2 per cent solution begun. August 14: Temperature now normal. Weight 114 pounds. Total tartar emetic to date, 0.965 gramme. September 3: Spleen four inches below costal margin. Blood count, reds 4,997,000, whites 2,872 per cubic millimetre. October 27: Leucocytes, 3,125. November 11: Spleen three inches below costal margin. November 23 to 30: Had a severe attack of pneumonia which resolved by crisis on the evening of the 29th. December 9: No injections have been given since November 22. The spleen is not now palpable. The inter-current pneumonic infection has probably contributed to the rapid reduction in the size of the spleen. January 3, 1917: The spleen can just be felt at the costal margin. During December only four injections were given. February 4: Leucocytes, 8,750. Five injections of five cubic centimetres each were given during January but they are now stopped. Total amount of tartar emetic given, 4.665 grammes. February 24: Weight 125 pounds. July 2: Patient had an attack of diarrhoea in June, but with this exception has been in good health. Spleen normal. Leucocytes 9,600. Weight 124 pounds.

Case 4.—Staff-Serjt. J. M., Grass Farms, aged 33. Condition before treatment begun—very anæmic and debilitated, weight 122 pounds, temperature high at times, fluctuating and irregular. Red blood cells 4,340,000, and leucocytes 5,400 per cubic millimetre. Spleen enlarged to three inches below the costal margin. Liver enlarged and measuring $9\frac{1}{2}$ inches in the nipple line. July 12, 1916: Spleen punctured and *Leishmania* found in the smears. July 18: Treatment with tartar emetic begun in 1 per cent solution. July 28: No improvement in temperature which is still high. Injections with 2 per cent. solutions begun to-day. Total amount of tartar emetic to date 0.155 gramme. August 22: Temperature has been steadily falling and from to-day becomes normal. Total tartar emetic to date 0.915 gramme. From August 23 to October 6, injections of tartar emetic were given every three or four days. The temperature remained normal and the weight increased to 137 pounds. The spleen decreased in size two inches. October 7: An attack of acute perisplenitis with a temperature of 104.4° F. and acute pain. October 8: Temperature normal and pain much relieved. October 10: Spleen increased in size again and extends to three inches below costal margin. October 17: Sudden rise of temperature to 104° F. with pain in right side and right shoulder and symptoms of perihepatitis. November 10: Spleen is now $1\frac{3}{4}$ inches below costal margin and the liver has also decreased in size. Temperature has been normal since November 1, and the injections are again being regularly administered as they were stopped during the attacks of splenitis and hepatitis. January 3, 1917: Spleen four inches below costal margin. Temperature normal; weight 136 pounds. January 21: Condition the same. Weight 138 pounds. Pulse rapid but patient is able to be up all day. He eats and sleeps well. Antimony treatment continued. January 30: Developed pneumonia and expired suddenly from heart failure on February 9. Altogether 5.215 grammes of tartar emetic were given intravenously. The patient's progress in the earlier stages of the treatment was most promising but latterly he remained in a more or less stationary condition. Though the fever was under control the spleen remained enlarged. There is no doubt that he had been suffering from kala-azar for a long time before his arrival

at Naini Tal and it is doubtful, quite apart from the intercurrent pneumonic infection, whether the treatment would have effected a complete cure.

Case 5.—Pte. J. M., "C" Company, Middlesex Regiment, aged 24. October 24, 1915: Spleen punctured. Leishmania present. Temperature is high and remitting from 102° F. to 104° F. in the evenings to 98° F. to 100° F. in the mornings. Leucocyte count—2,725. Liver slightly enlarged. Spleen enlarged to four inches below the costal margin. October 27: Intravenous injections of 2 per cent tartar emetic begun. November 9: Liver enlarged to three inches below costal margin. Spleen 4½ inches below costal margin. Temperature the same but lower in the mornings. November 15: As the temperature shows a tertian rise, quinine is given by the mouth and has a steadying effect. November 27: From to-day the temperature becomes normal. Total tartar emetic to date—0.64 gramme. December 1: Spleen three inches below costal margin. Weight 132 pounds. February 5, 1917: Spleen four inches below costal margin. Weight 158 pounds. Total tartar emetic to date—2.73 grammes. March 24: Spleen not palpable. Leucocytes 7,812. Treatment stopped. Total tartar emetic given—4.61 grammes. July 2: With the exception of an attack of diarrhoea in June he has been in good health. Spleen normal. Leucocytes 8,200. Weight 152 pounds.

Case 6.—Pte. S. C., "A" Company, Middlesex Regiment, aged 26. January 19, 1917: Spleen punctured. Leishmania present. Temperature in the evenings 101° F. to 103° F. and in the mornings 98° F. to 100° F. Leucocytes 5,625. Spleen 5½ inches below costal margin. January 20: Treatment with 2 per cent solution tartar emetic begun. February 5: Temperature has been falling steadily and is now normal. Total tartar emetic to date, 0.30 gramme. Weight 126 pounds. April 7: Leucocytes 9,375. Weight 144 pounds. April 13: Last day of treatment. Total amount of tartar emetic given, 2.75 grammes. April 15—April 19: Suffered from gumboil with rise of temperature to 103° F. April 27: Leucocytes 7,031. Spleen not palpable. May 13: Weight 150 pounds. July 2: He has been in good health ever since. Spleen normal. Leucocytes 11,000. Weight 175 pounds

SUMMARY.

Condition before treatment	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Leucocytes	5,480 ..	4,914 ..	2,872 ..	5,400 ..	2,725 ..	5,625 ..
Size of spleen below costal margin	7 in. ..	4 in. ..	5 in. ..	3 in. ..	4 in. ..	5½ in.
Weight—lbs.	119 ..	134 ..	109 ..	122 ..	192 ..	126 ..
Temperature became normal in days	31 ..	36 ..	36 ..	35 ..	30 ..	17 ..
Grammes of tartar emetic injected	0.595 ..	0.945 ..	0.965 ..	0.915 ..	0.64 ..	0.3 ..
Spleen became normal in days	190 ..	100 ..	180 ..	— ..	150 ..	90 ..
Total amount of tartar emetic administered—grammes	6.515 ..	3.645 ..	4.665 ..	5.215 ..	4.61 ..	2.75 ..
Weight gained—lbs. . .	2 ..	22 ..	16 ..	— ..	26 ..	24 ..

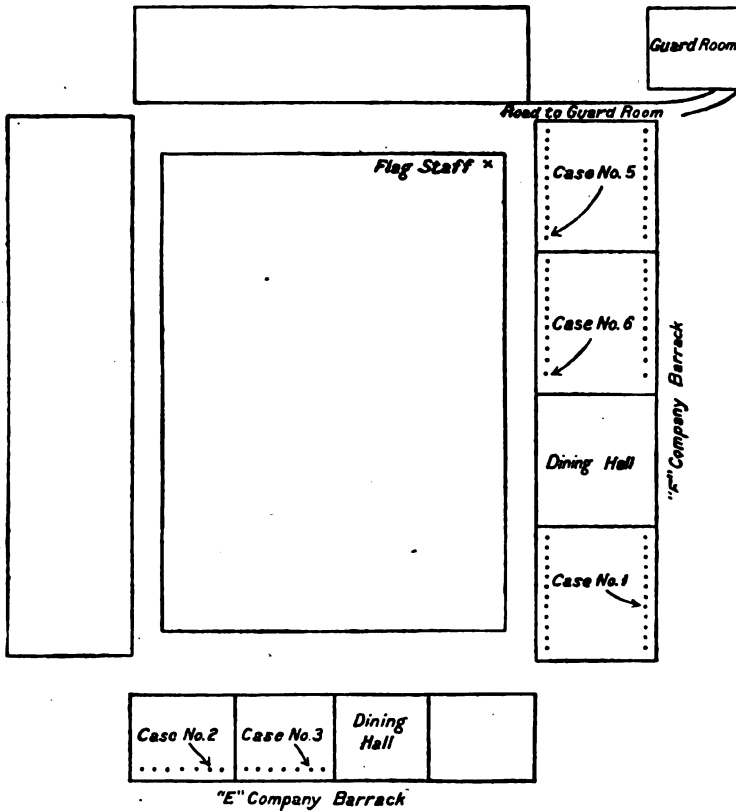
A few remarks on the treatment may be of interest.

The injections are given with a large all-glass syringe into one of the veins at the bend of the elbow which is made prominent by means of pressure on the upper arm applied by an assistant. To make sure that the point of the needle is inside the vein, some blood is drawn up into the syringe, and this also gets rid of any air that may have lodged in the needle. The escape of any of the antimony solution

into the surrounding tissues must be carefully avoided, otherwise much local irritation and pain is produced, and sloughing may result.

The injection should not be given just before or immediately after a meal.

It has been my practice to begin with 2 cubic centimetres of the 2 per cent solution, and gradually increase the dose by $\frac{1}{2}$ cubic centimetre every second day until a dose of 4 or 5 cubic centimetres is reached. The interval between each dose is then lengthened to two or three days.



PLAN No. 1.—Dum Dum, December, 1914, to February, 1915.

In three of my cases I was unable to give a larger dose than five cubic centimetres without producing rather distressing symptoms. Two of the cases were able to stand seven cubic centimetres well, viz., Nos. 5 and 6, and these were the two that responded most quickly to the treatment.

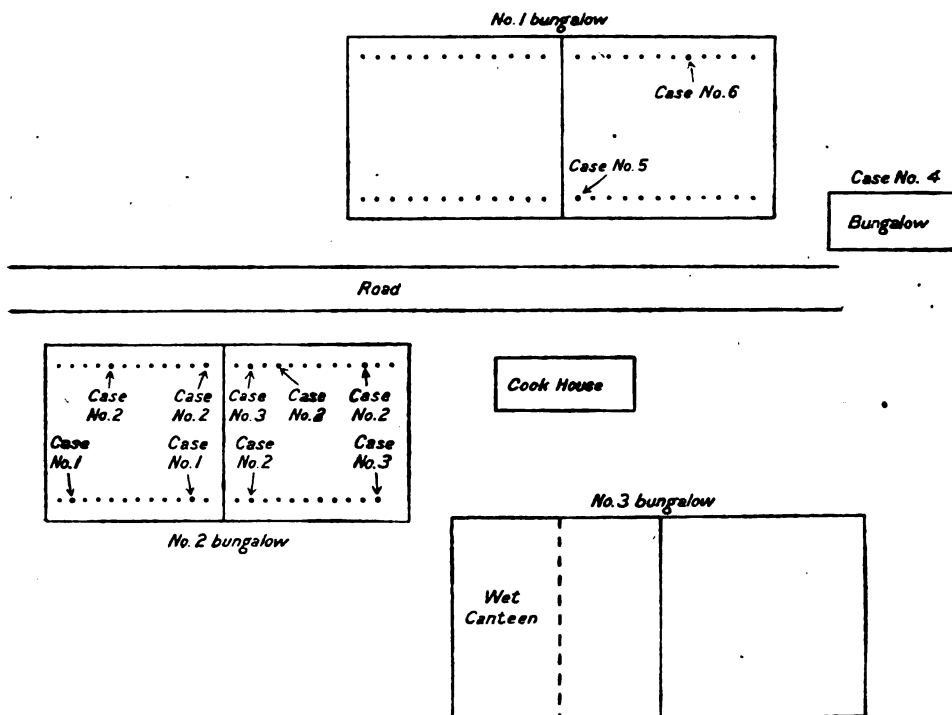
The symptoms produced by a maximum dose are immediate and almost unbearable tickling in the throat accompanied by a short dry cough and sneezing. A little later a feeling of sickness may supervene. The patient soon learns to exercise a little self-control, and lie absolutely still on his back until this discomfort has passed off. For some hours after, the patient feels "unsettled," and, perhaps, irritable, and occasionally a headache supervenes. Most of the patients complained

of aching of the teeth. Very rarely the feeling of sickness was succeeded by retching, and even vomiting.

When the temperature became normal, the patient's maximum dose was administered twice weekly, and when the spleen became normal, the dose was given once a week for about a month.

(2) Notes on the Epidemiology.

Five of these cases belonged to the same regiment—the Middlesex. The regiment arrived in India in December, 1914, and proceeded to Dum Dum. One man belonged to "E" Company, three to "F" Company, and one to the Signal section. For the two months during which they were stationed in Dum Dum, they occupied barrack-rooms, as shown in Plan No. 1.



PLAN NO. 2.—Barrackpore: Plassey Barracks, February 20 to December 10, 1915.

A fortnight was then spent in a camp at Jafferpore, and subsequently Cases 1, 2, 5, and 6 proceeded to Barrackpore about February 20, 1915. When "E" and "F" Companies were amalgamated into "C" Double Company, the fifth man (Case 3) joined the others at Barrackpore in June, 1915.

The barrack-rooms and the position of the beds occupied by these men during their stay in Barrackpore is shown in Plan No. 2. It will be noticed that several of them did not occupy the same bed during the whole time. - They remained at Barrackpore till the middle of December, 1915; thence they proceeded to Dinapore,

but remained there only about a month, and on January 24, 1916, arrived at Rawal Pindi.

Case 1 was admitted to hospital on February 22, and transferred to Naini Tal on April 6, and diagnosed kala-azar on July 2.

Case 2 was admitted to hospital on February 1, and transferred to Naini Tal as a convalescent on May 19. Reported sick with fever on January 26, and diagnosed kala-azar by spleen puncture on July 4.

Case 3 was admitted to hospital on April 14, and transferred to Naini Tal on May 25. Diagnosed kala-azar by spleen puncture on July 6.

Case 5 was in hospital for four days in February suffering from fever, supposed to be malaria, but no parasites were found in the blood. In the beginning of June he was seized with a continuous high fever, admitted to hospital on the 8th, and transferred to Naini Tal on August 12. Diagnosed kala-azar by spleen puncture on October 24.

Case 6 was admitted to hospital for broncho-pneumonia on May 5, and re-admitted on June 19 with a continuous high fever, and transferred to Naini Tal on August 12. Diagnosed kala-azar by spleen puncture on January 19, 1917.

The sixth case (No. 4) was a staff-serjeant who had served for ten years continuously in India, chiefly in Bengal. From April, 1913, to December, 1915, he served in Barrackpore, and during that period spent seven months in the Sunderbunds. He was a married man, and lived in the bungalow shown on Plan No. 2.

In July, 1915, he suffered from malaria, which resisted treatment, and he was transferred to Rawal Pindi on account of his health. Immediately after his arrival in Rawal Pindi in December, 1915, he had to be admitted to hospital suffering from malaria complicated with severe colitis. He became critically ill, and though kala-azar was suspected, he was diagnosed enteric fever. He was transferred to Naini Tal on May 4. Kala-azar was diagnosed by spleen puncture on July 12.

There would seem to be no doubt that all the six cases contracted the disease at Barrackpore. Further, I am given to understand that since the discovery of these cases which I duly reported, others from the same regiment have since been diagnosed in Rawal Pindi.

It would be of interest if the particulars of these cases could also be published with a view to piecing together all the facts of this epidemic.

CLINICAL TYPES OF SUBTERTIAN MALARIA, AS SEEN IN SALONIKA IN SEPTEMBER, OCTOBER, AND NOVEMBER, 1916.

BY MAJOR A. W. FALCONER.

Royal Army Medical Corps.

AND

CAPTAIN A. G. ANDERSON.

Royal Army Medical Corps.

DURING September, October, and November we have had an opportunity of seeing over 3,600 cases of malaria. The diagnosis of malaria has been founded either on a positive blood finding, or on the history of the case, temperature chart, and a definitely hard palpable spleen. In a small proportion of the cases other infections were present, in addition to malaria. In isolated cases a double infec-

tion with subtertian and quartan parasites was found. Owing to the fact that in some forty per cent of the cases we were unable to demonstrate the parasites in the peripheral blood-stream, we are not in a position to give exact figures of the relative amounts of benign to subtertian infections, but there can be no doubt that during this period the percentage of subtertian infections was very high. The relatively high proportion of the negative blood finding is due to the fact that practically all the patients were under the influence of quinine on admission to the hospital, and many of them had been several days under hospital treatment before admission to a base hospital. Further, owing to the pressure on the beds, it was generally impossible in the less severe cases to make more than one blood examination.

The chief types of subtertian malaria seen during this period were as follows:—

The majority of the cases were of the simple subtertian, double subtertian, and irregular types of subtertian pyrexia, without local manifestations. These cases uniformly responded well to treatment with quinine.

The most important group of cases with local symptoms, both on account of relative frequency and on account of the difficulty of the differential diagnosis, were characterized by more or less urgent gastro-intestinal symptoms. This group could be separated into several more or less definite types.

DYSENTERIC.

A large number of the cases were sent into hospital with a diagnosis of dysentery. A prominent symptom of these cases was the presence of diarrhoea. The great majority of the patients stated that they were passing "blood and slime"; but it must be remembered that this is a mere formula with most of them, and of no value in diagnosis. In most of these cases the stools were fluid fæculent stools without definite blood or mucus, and they varied in number from six to fifteen or more in twenty-four hours. These cases rapidly improved under quinine treatment.

In a smaller number of cases the stools contained definite blood and mucus. It was possible in the great majority of these cases to demonstrate a superadded infection with one of the organisms of the dysenteric group. In a few other cases patients admitted with malaria, but without dysenteric symptoms, developed genuine bacterial dysentery; and, again, cases with bacterial dysentery, after a few days in hospital, showed genuine malaria with protozoa in the blood.

In a few cases where the diarrhoea tended to persist, concurrent infections with *Lambia intestinalis*, *Tetramitus*, *Trichomonas*, and *Balantidium coli* were demonstrated.

Apart altogether from these cases, however, there were a considerable number of patients admitted whose dominant symptom was diarrhoea, and in whom repeated examinations of the stools failed to demonstrate any dysenteric organisms or amœbæ. Several of these cases died, and the autopsy showed, in some, slight congestion of the colon chiefly in its upper part; in others definite small submucous hæmorrhages; and in one, to be described in detail, extensive submucous hæmorrhages, but a perfectly intact mucous membrane. In many of these cases the bowels moved at first from twenty to thirty times a day. The stools were liquid fæculent stools, not unlike Worcester sauce. In the majority this diarrhoea very speedily subsided under energetic quinine treatment. In some the stools were fæcal, liquid, more or less heavily tinged with blood, and very

characteristic—notably bile stained. This stool, although containing blood and traces of mucus, is yet macroscopically quite distinct from the typical dysenteric stool. As examples of those types we may quote the following cases:—

Cpl. F., aged 32, admitted on September 20, 1916, with profuse diarrhoea and pyrexia. The bowels were moving about every hour. The stools were fluid, fæculent, and heavily tinged with bile and blood. The spleen was enlarged and hard, and the blood-film showed a very heavy infection, with subtertian parasites of all types, rings, rosettes, and crescents. He was treated with intravenous quinine and salines. The stools were examined for organisms of the dysenteric group and protozoa with a negative result. The diarrhoea continued, the stools constantly containing blood and traces of mucus. Ultimately the patient became incontinent, and died eight days after admission.

Post-mortem.—The spleen was enlarged to four times its normal size. The large intestine showed moderate congestion with small punctate submucous hæmorrhages. There was no ulceration, and the whole mucous membrane was smooth and glistening.

Serjt. B., aged 24. He was sent into hospital on September 2, 1916, with a history of having been unwell for nine days, at first with constipation, abdominal pain and vomiting. Three days before admission he began to suffer from severe diarrhoea. On admission, the patient was collapsed, and the bowels were moving every half hour. The stools were liquid, fæculent, and heavily stained with blood and bile. There was marked icteric tinging of the sclerotics. The blood showed the presence of numerous subtertian rings. The diarrhoea continued, and ultimately the motions appeared to consist of almost pure blood.

Post-mortem.—The whole of the large bowel showed a macroscopically intact smooth glistening mucous membrane without any suggestion of ulceration. Extensive submucous hæmorrhages were present throughout the whole of the large bowel.

CHOLERAIC PERNICIOUS FEVER.

Fortunately only two cases of this type were met with. Both of these cases died within fifteen hours of admission in spite of intravenous quinine and salines.

Pte. K., admitted on September 14, 1916, from a camp alongside our lines. On admission, the patient was in a state of profound collapse, with subnormal temperature, sunken cheeks, blue nails, and cold cyanotic extremities. Mentally the patient was dull, and it was difficult to get a history, but it appeared that he had not been well for two days, although he remained on duty till the day of admission. Parasites were not found in the blood-films. There was incontinence of fæces and a watery brown fluid, without visible blood or mucus, continued to ooze from the anus. He died within twelve hours of admission to the hospital.

Post-mortem.—The spleen was slightly enlarged, and almost diffuent. The colon and sigmoid flexure presented moderate congestion, but no trace of ulceration. Smears from the spleen, after a prolonged search, showed rings and crescents of subtertian malaria.

The second case was exactly similar, except that it was a second attack, and that the parasite was readily found in the blood.

APPENDICULAR TYPE.

Cases strongly suggesting appendicitis have not been very infrequent. In all we have seen some twelve cases of this type. In these cases the chief complaint

was vomiting, and severe pain referred to the right iliac fossa, associated with moderate pyrexia and marked tenderness and rigidity in the right iliac fossa. In most of the cases it was possible to show that the rigidity was not constant. In some of the cases the tenderness was most marked somewhat above McBurney's point. In others it corresponded accurately with this point. In all of our cases we were able to demonstrate either the presence of the parasite in the blood, or a definite enlargement of the spleen. None of our cases showed a leucocytosis, and all had the typical relative lymphocytosis of malaria. All rapidly cleared up under quinine treatment. We have also seen a few cases in which the abdominal pain and rigidity were so marked and so diffuse as to suggest an acute abdomen, but these also rapidly cleared up under the use of quinine, with the exception of one case, which was complicated with septicæmia. This, at the autopsy, showed a purulent pleuritis and peritonitis, in the exudates of which streptococci were demonstrated.

BILIOUS REMITTENT FEVER.

Thirteen, or fifty per cent of our fatal cases, were of this type. These cases had all been ill several days before admission to the base hospital. On admission, they were collapsed, with marked yellowing of the conjunctivæ and a peculiar earthy facies. They suffered much from almost constant vomiting, and the majority from bilious diarrhœa and mental confusion. After treatment by intravenous quinine and intravenous saline, they improved from a condition of apparently extreme urgency to one of relative comfort, but, unfortunately, the improvement was not maintained, and after a period of from two to five days their condition again became critical. The jaundice became deeper, the vomiting, often accompanied by uncontrollable hiccough, again became severe, the bowels incontinent, the temperature rose, and they died in coma or delirium.

Post-mortem.—The chief macroscopic features were enlargement of the spleen and submucous hæmorrhages in various organs, and the presence of a gall-bladder distended with thick dark bile.

PERNICIOUS FEVER WITH PULMONARY SYMPTOMS.

Both numerically and as a cause of death, the next most important group was that in which the patients' dominant symptoms were referred to the respiratory tract. Of twenty-six cases of malaria which terminated fatally, pulmonary complications of a pneumonic or broncho-pneumonic character were present in seven, and were the immediate cause of the fatal issue.

Amongst the patients admitted to the hospital were a large number who complained of respiratory symptoms, and some who were admitted under the varying diagnosis of bronchitis, broncho-pneumonia, and congestion of the lungs, were found subsequently to be suffering from subtertain malaria. In them the malarial parasite could be demonstrated in the blood.

Amongst these cases were a small proportion who, in addition to their malaria, gave a history and presented the physical signs of a chronic bronchitis and emphysema, and in them the occurrence of a malarial attack caused a decided increase in their symptoms and physical signs.

In the majority of cases, however, there was no history of bronchitis nor any evidence of emphysema. Amongst these the pulmonary complications could be divided into the bronchitic, the broncho-pneumonic and pneumonic.

THE BRONCHITIC.

The patients complained of pain and tightness in the chest with persistent cough accompanied by expectoration. They presented the ordinary signs of a diffuse bronchitis with numerous rhonchi and râles scattered all over both lungs. Some showed the typical malarial pyrexia, others an irregular intermittent pyrexia, while others ran a normal or subnormal temperature throughout their stay in hospital. They differed from an ordinary bronchitis only in the presence in the blood of the malarial parasite, and their rapid response to treatment by quinine. It is not suggested that the bronchitis is caused by the malarial parasite, and it may be that the bronchitis is nothing more than that which is usually associated with the onset of any acute febrile illness. Nevertheless the respiratory symptoms are so well marked and the patient's complaint is so entirely referred to his chest that one is, we think, justified in separating out a definite clinical group—the bronchitic.

PNEUMONIC AND BRONCHO-PNEUMONIC.

The term *pneumonic* is not strictly accurate for the whole of this group of cases, and all that it is meant to convey is that we are dealing here with a group of cases in which the physical signs suggest that there are in the lungs areas of more or less extensive consolidation, some definitely lobar, others lobular or confluent lobular. To this group belong the fatal cases already referred to. In all of these seven cases subtertian parasites were demonstrated in the blood, and in all were definite physical signs, in some lobar, in others lobular consolidation.

LOBAR CONSOLIDATION.

Of these seven cases at autopsy four showed definite lobar consolidation of one or more lobes, complicated in two cases by hæmorrhagic pleurisy. These showed the ordinary macroscopic appearance of lobar pneumonia in the grey hepatic stage.

LOBULAR CONSOLIDATION.

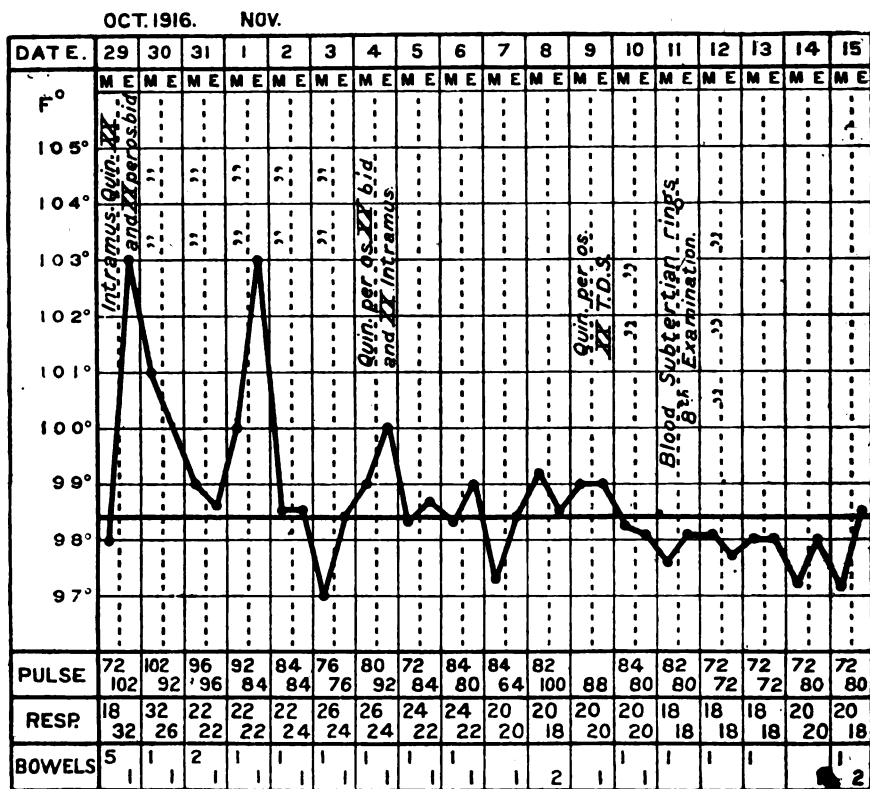
In the other three cases there was extensive lobular consolidation of both lungs. In one case there was present, in addition to the broncho-pneumonia, twelve ounces of blood-stained serous fluid in the pleural cavity.

In both these groups we would appear to be dealing with a superadded infection in which the malarial parasite was at the most but a predisposing cause. It is worthy of note, however, that during this period only one case of pneumonia unassociated with malaria was admitted.

A third group comprised a series of cases which from the onset of the illness presented definite pulmonary physical signs and symptoms which pointed to areas of definite consolidation in the lungs, though the course of the disease was not that of a true lobar or lobular pneumonia. Two cases will be described in detail. In both subtertian parasites were demonstrated in the blood.

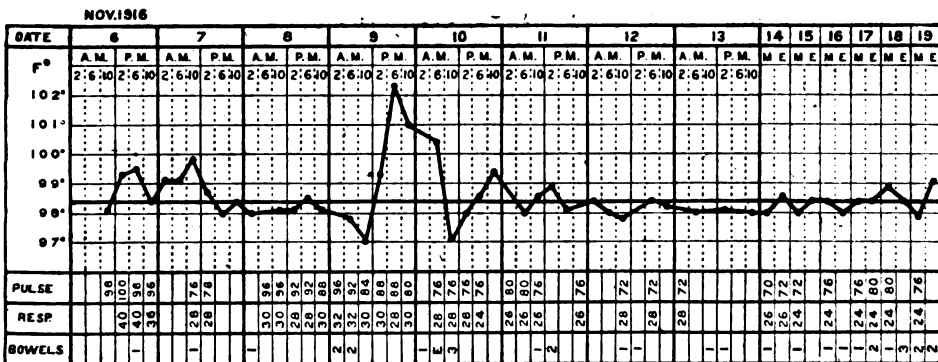
Private F., aged 20, reported sick on October 22, 1916, complaining of shivering, malaise, and diarrhœa. Admitted to hospital on October 29, 1916. He was pale, with a slight icteric tint of the sclerotics. The spleen was three fingers' breadth below the costal margin. Over the left lower lobe posteriorly there was evidence of consolidation with bronchial breathing and numerous medium-sized moist râles. Anteriorly there was bronchial breathing in the second, third and

fourth left intercostal spaces. There was no definite dullness on percussion either anteriorly or posteriorly, and the vocal resonance and fremitus were not markedly increased. The lung condition remained practically unchanged until November 13, 1916, when the breath sounds lost their bronchial quality, became a little weak, and a friction rub developed over the left lower lobe posteriorly. On the day of admission the temperature rose to 103° F., his pulse to 112, and his respirations to 32. Next day the temperature did not rise above 99° F., but on the following day again rose to 103° F. It fell again on the subsequent day and remained normal from that point onwards. The pulse respiration ratio was not at any time much disturbed. There was little cough and no expectoration. He was treated with twenty grains of quinine intramuscularly twice a day for the first six days, and then by twenty grains intramuscularly and forty grains by mouth for the next seven days.



Lance-Cpl. I., aged 29, reported sick on November 1, 1916, complaining of pain in the chest, headache and shortness of breath, no shivering. On November 4, 1916, he was admitted to hospital with a diagnosis of congestion of the lungs. He did not have the general appearance of pneumonia nor did he look very ill. Dyspnoea was evident only on exertion. The spleen was just palpable. The whole of the right lung was involved. Anteriorly the breath sounds above and

below the clavicle were bronchial, and all over the anterior aspect of the lung were numerous moist, sticky râles. The movement was diminished but there was no appreciable percussion dullness. Posteriorly there was slight percussion dullness over the right supraspinous fossa and over the right base. The breath sounds over the supraspinous fossa were bronchial and distinctly tubular in a small area just below the spine of the scapula. Numerous râles were present all over the right lung and a few râles at the left base. On admission his temperature was 99.8° F., his pulse 96, and his respiration 36. On the following day the temperature was again 99.8° F., falling on the third day to normal. On the fourth day his general condition became worse. The temperature rose to 102.8° F., and for two days the patient lay in a curious state of wandering delirium. His temperature fell on the following day and did not rise above 99° F. at any other period of his illness. During the sudden rise in temperature the pulse was 84, and the respirations 30, showing a distinct disturbance of the pulse respiration ratio. The signs over the right side of the chest gradually diminished, but on November 12, 1916, without any rise of temperature or any increase in the patient's symptoms, a large area of consolidation was found over the left lower lobe posteriorly accompanied by numerous moist râles. On November 27, 1916, the right lung was completely clear but the left lower lobe still showed bronchial breathing and râles. At no time was there any expectoration. Treatment was carried out with quinine by mouth.



These cases have been detailed because, although the chest signs and symptoms were perfectly well defined, suggesting a lobular consolidation, the course of the disease was certainly not that of lobular pneumonia. One of the cases showed a disturbance of the pulse-respiration ratio, the other did not. Neither case had any expectoration. In neither case was the temperature chart that of a pneumonia, but was certainly characteristic of a malarious attack. In both cases subtertian parasites were found in the blood. The character of the pulse remained good throughout the course of the disease and at no time were the patients seriously ill.

It is difficult to suggest what the exact pathological condition in those cases is, but we believe that there is a definite clinical type of malaria associated with the physical signs of more or less extensive consolidation of the lungs, in which there is no evidence whatever of a superadded infection. This type may be conveniently designated the pneumonic.

CEREBRAL CASES.

An extremely interesting but relatively small group of cases presented cerebral symptoms of the well recognized cerebral types, but, as we intend to describe these later in detail from the point of view of treatment, we will only briefly mention them here. In all we have had nine cases in which the dominant symptoms have been due to local affections of the nervous system. Two of these were of the bulbar type and showed temporary paralysis of the muscles supplied by the bulbar nuclei; both recovered and were discharged from the hospital without any evidence of organic disease. One patient was admitted with a diagnosis of debility. Twenty-four hours after admission he suddenly became comatose and remained so for fifteen hours. He also completely recovered. One patient twenty-one hours after admission, while in the latrine, developed an epileptiform fit. These fits, which were of a general epileptiform character, were repeated about twelve times in the following twenty-four hours. The left leg became somewhat weaker than the right and developed an extensor plantar reflex which at the time of writing is still present. In addition the patient still presents definite nystagmus and a tendency to a reeling gait, but no evidence of active disease.

In four cases the most marked symptom was violent delirium which persisted for several days uninfluenced by variations in the temperature. In three of the cases there was a high intermittent pyrexia, in one the temperature was never above 99° F. In all the cases subtertian parasites were demonstrated in the blood and all the cases completely recovered. One patient presented meningitic symptoms associated with pneumonia at the right base. This patient died. The autopsy showed a considerable excess of cerebrospinal fluid beneath the tentorium with oedema of the pia-arachnoid over the base, and congestion of the vessels over the pons. Section of the brain after hardening in formalin showed no evidence of gross brain disease. The middle and lower lobes of the right lung presented the features of an ordinary croupous pneumonia.

GENERALIZED OEDEMA WITH ASCITES.

Two cases were admitted complaining of breathlessness, and generalized oedema.

Driver W., aged 35. Reported sick on October 6, 1916, complaining of breathlessness, swelling of the feet, legs and face, and headache. Admitted to hospital on October 9. On admission there was considerable oedema of the hands, feet and legs, and the eyelids were puffy. The visible mucous membranes were almost colourless, and there was some lemon-coloured tinting of the sclerotics. The abdomen was tolerably distended, the subcutaneous tissues were oedematous and there were all the characteristic signs of a considerable accumulation of free fluid in the peritoneal cavity. The spleen extended almost to the umbilicus. The liver was not enlarged. There was a slight mitral systolic murmur, the rate of the pulse was 78, and the rhythm of the heart was normal. The apex beat was in the fourth space in the nipple line. Nothing abnormal was made out in the lungs; the urine was of a specific gravity of 1012, clear straw coloured. It did not contain albumin, bile or sugar. The deposit showed a few uric acid crystals but no casts. The temperature was normal on the day of admission, October 9, 1916, but rose to 103° F. on the evening of the 10th, to fall

on the morning of the 11th to 99.8° F. From the 15th onwards the temperature remained normal. A blood-film showed the presence of subtertian rings and crescents. Treatment by intravenous quinine was commenced on the 10th, and later continued intramuscularly and by the mouth. On the 12th the condition of the patient was immensely improved and the œdema of the feet and hands had almost disappeared and it was no longer possible to demonstrate free fluid in the abdominal cavity. On the 16th the blood was free from parasites and he was discharged to hospital ship on the 23rd.

Private B., aged 25, reported sick on October 27, 1916, complaining of swelling of the legs and breathlessness. Previous to the present illness he had always been healthy. He was admitted to the hospital on October 27. On admission the patient presented notable œdema of the legs and of subcutaneous tissues of the back and abdomen and the eyes were puffy. The visible mucous membranes were pale and there was a slight lemon tint of the sclerotics. The abdomen was considerably distended and gave all the characteristic signs of free fluid in the abdominal cavity. The spleen extended almost to the umbilicus and the lower margin of the liver was $\frac{1}{2}$ inch below the costal margin. The apex beat of the heart was in the fifth space almost in the nipple line. The pulse-rate was 96 and the rhythm normal. The second pulmonic sound was not definitely accentuated. Nothing abnormal was made out in the lungs. The urine did not contain albumin or casts. The blood-film showed the presence of subtertian crescents and rings and the red blood cells showed marked anisocytosis and polychromatophilia. The temperature was normal and remained so. The patient was treated at first with intramuscular quinine, and later with quinine by mouth. By November 11, the œdema of the extremities and the physical signs of ascites had completely disappeared. He was discharged to a hospital ship on November 15.

In these two cases we have the presence of œdema of the face and extremities and notable ascites without any evidence of either primary heart or renal disease. Both cases showed the presence of subtertian parasites and both very rapidly cleared up under quinine treatment. Apart from the absence of any evidence of heart disease the distribution of the œdema, affecting the face, and the presence of a notable amount of ascites without enlargement of the liver is sufficient to exclude a cardiac origin for the œdema. Similarly the presence of a perfectly normal urine in both cases excludes a renal origin. We would suggest that the œdema is of toxic vascular origin similar to the œdema and ascites seen in the late stages of multilobular cirrhosis of the liver.

GANGRENE OF THE FEET.

Another group consisting of three cases showed evidence of local vascular changes in the development of gangrene of the toes.

Pte. B., A.S.C., aged 26, admitted to the hospital on October 4. He reported sick on October 1, complaining of loss of the use of his legs and numbness of his feet. He stated that he had not been unduly exposed before reporting sick. On admission to the hospital the temperature was 102° F., the conjunctivæ were slightly icteric and the spleen was palpable. A blood-film showed the presence of numerous subtertian parasites. He complained of very severe pain in both feet shooting up the legs, both feet were considerably œdematous and over the

dorsum of each foot was a large purple ecchymosis. The great toe and all the smaller toes of the right foot and the small toes of the left foot were slightly swollen and almost black in colour. On the soles of both feet, from the bases of the toes backwards for a distance of about one inch, the skin was purple in colour. Sensation to gross touch was still present, the dorsalis pedis and posterior tibial arteries of both feet could be felt pulsating quite strongly. As it was considered possible that a vascular spasm aggravated by quinine might be a factor in the condition, the patient was not given quinine but was treated with four grammes galyl intravenously. Next morning the temperature had fallen to normal and remained so for the remainder of the patient's stay in hospital. The patient's general condition generally improved and the blood was reported negative to malaria on the 10th. The feet rapidly improved, and apart from slight superficial necrosis on the dorsum of the right foot completely recovered. On October 14 he was put on twenty grains quinine sulphate daily by mouth and was discharged to hospital ship on October 28.

Pte. M., aged 24, admitted to hospital on October 11. He reported sick on October 5 complaining of shivering, pains in the head and back. For three weeks before reporting sick his company had been resting behind the line. On October 7 when taking off his boots he noticed that his feet were cold and that his toes were blue. He found that he was unable to stand on his feet on account of pain, and because "he could not feel his feet." On admission to the hospital his only complaint was pain in his feet. He presented distinct icteric tinging of his sclerotics and his spleen was palpable. Both feet showed discoloration of the toes, the left foot being more affected than the right. All the toes of both feet were affected, the colour varying from brownish purple to purple. On the left foot the plantar surface of all the toes showed small bullæ, on the right foot only the larger and third toes presented bullæ. The dorsalis pedis and the posterior tibial arteries of both feet could be readily felt pulsating. Patient was put on one drachm quinine sulphate daily and steadily improved. Both feet recovered without any loss of tissue.

Drvr. W., aged 21, admitted to the hospital on October 9 with a diagnosis of malaria. He reported sick about ten days before admission to the base hospital on account of shivering and pain in the head and back. On the second day of admission to a field ambulance, the feet become very cold and continued so in spite of hot bottles. On the next day the feet were seen to be blue. On admission to the base hospital there was considerable œdema of both feet, all the toes of both feet were blue with large bullæ, especially on the right big and second toes, extending for some distance over the dorsum of the feet. Several of the bullæ were burst and were discharging a seropurulent fluid. The dorsalis pedis and posterior tibial arteries could be felt beating quite strongly in both feet. There was marked icteric tinging of the sclerotics and the spleen was palpable one inch below the left costal margin. A blood-film showed no malarial parasites. The patient on admission was given an intravenous injection of four grammes galyl and ten days later was put upon quinine. The patient's general condition rapidly improved, but considerable sloughing occurred over the dorsum of the large and second toes of the right foot, involving the loss of the nail of the great toe and opening into the first interphalangeal joint of the second toe. There was also slight superficial sloughing over the dorsum of the left large toe.

Thirty cases infected with malaria have died. Of these, one was a case of subtertian malaria who was quite convalescent from malaria when he developed an extremely septic throat followed by pneumonia.

Post-mortem.—There was ulceration of the pharynx and epiglottis with septic consolidation of both lower lobes of the lungs. In two cases there was in addition to malaria a Shiga dysentery and the patients died of running dysentery. Post-mortem in both cases almost the entire mucous membrane of the whole of the lower bowel and the lowest two feet of the ilium were destroyed.



FIG. 3.

MORTALITY AND POST-MORTEM FINDINGS.

One case died of amœbic dysentery and septicæmia. The mucous membrane of the lower bowel was much destroyed and there were abscesses in both kidneys. Four cases died of lobar pneumonia affecting one or more lobes. In one of those there was in addition an extensive hæmorrhagic pleural exudate. In those cases malaria was not the cause of death. This leaves twenty-two cases with a total case mortality of 0·61 per cent. Three cases presented at the autopsy extensive lobular consolidation of the lungs, complicated in one by hæmorrhagic pleurisy. The immediate cause of death in those cases was also probably the lung condition, and it is a debatable question whether they represent a double infection or a true complication of malaria. Two cases died of septicæmia. One was admitted to hospital with a septic arm following an intramuscular injection of quinine. At the autopsy pyæmic abscesses were found in the lungs and kidney and recent vegetations on the mitral valve. One was admitted in an extremely collapsed condition with numerous septic sores on both arms and developed signs of pleural and peritoneal effusion. At the autopsy there was found a right-sided septic pleural effusion and septic peritonitis. Streptococci were recovered from the pleural and peritoneal fluids.

Excluding those five cases we have seventeen cases of uncomplicated malaria at a mortality of 0·47 per cent.

In one case the autopsy disclosed moderately advanced granular kidneys, and

in one case a right-sided hydronephrosis which had largely destroyed the right kidney.

We take this opportunity of thanking Colonel Purves Stewart, C.B., A.M.S., Consulting Physician to the Salonika Forces, for his valuable assistance and advice which was always at our disposal during this period. To Lieutenant-Colonel Mitchell we are also indebted for permission to use the hospital records, and to Captain Richards, R.A.M.C. (T.F.), for the hæmatological and bacteriological and post-mortem reports.

MEMORANDUM ON THE TREATMENT OF PAINFUL SHINS FOLLOWING TRENCH FEVER, BY ELECTRO-THERAPEUTICAL METHODS.

BY CAPTAIN A. J. H. ILES.

Royal Army Medical Corps (T.F.).

Officer in Charge of X-ray and Electro-therapeutical Department, General Hospital, British Expeditionary Force, France.

EVERY physician connected with troops on active service knows the condition which is now officially diagnosed as "trench fever."

He also knows that were it not for the "painful shins," which almost invariably follow, the vast majority of "trench fever" cases would be fit for duty in a very short space of time, whereas, in fact, thanks to these "painful shins," the convalescent stage of the disease is very long and disappointingly prone to exacerbation.

During the early part of this past winter I tried many things electrical for the relief of this condition, watching the cases in their wards, as well as in the electro-therapeutical department, and by the end of November I had come to the conclusion that the remedy par excellence was ionization combined with faradism.

My method is as follows:—

Using liquor iodi fort., a patch $1\frac{1}{2}$ inches wide and 3 inches long is painted, well outside and parallel with the anterior border of the tibia, in the middle third of the leg, and ionized for ten minutes, at a maximum of ten milliamperes, the negative electrode being placed over the painted area, a thick pad well soaked with two per cent sodæ salicylatis in three per cent sodium chloride being placed between.

On the second day, ionization, with sodium chloride only, is applied over the original site, the negative electrode being placed as before. Ionization is now stopped, and for the next three and subsequent days the muscles of the calf and leg are exercised for ten minutes daily with faradism.

As a rule the men tell me at their second or third visit that they have experienced immediate relief from pain; that they have slept better and feel much better in themselves, and where they do not do so the fact soon becomes obvious from their general appearance.

I watched the earlier cases for some weeks, keeping them to see if there was any tendency to recurrence, and having satisfied myself that there was not, I then proceeded to carry out the above course as a routine.

Below are the statistics of 100 consecutive cases received here from the wards for treatment.

Days under treatment	Number of cases
1	0
2	3
3	6
4	14
5	11
6	14
7	10
8	15
9	2
10	12
11	1
12	2
13	
14	3
16	1
20	1
21	1
22	1

Sent to England as unlikely to be well in three weeks 2

Average stay under treatment = 7.50 days. 100

It will be noted that two per cent were sent to England after treatment had been begun, owing to slow recovery, and that ninety-eight per cent were sent to duty "A," or convalescent depot, the latter means of evacuation being only used where it was thought that the man's general condition required a little longer rest.

I do not mean to write the history of this department, established under authority in May, 1915, until after its work is completed, but viewing the number of cases of "trench fever" which have hitherto spent weeks or months in hospital, and seeing the immediate and apparently lasting results of the above simple line of treatment, I take the liberty of putting it forward.

A METHOD OF STAINING BLOOD-FILMS

By CORPORAL J. L. YUILL, B.Sc.

Royal Army Medical Corps.

THE following method of staining blood-films has been found to give good results:—

(1) Cover the film with absolute alcohol for fifteen seconds, pour off the alcohol and wave the slide vigorously to dry it.

(2) Stain with dilute Manson's methylene blue for thirty seconds. Use a three per cent solution of the concentrated stain.

(3) Pour off the blue, and, without washing the slide, stain with very dilute eosin (a 0.025 per cent solution) for thirty seconds, and pour off the stain.

(4) Wash with distilled water for thirty seconds, and dry between sheets of blotting-paper.

The structure of leucocytes is brought out with excellent definition and colour

contrasts. Blood platelets and the very fine filaments connecting the nucleus lobes in "polymorph" cells show up with special clearness. The value of Manson's blue as a stain for the malarial parasite is added to by the use of eosin.

The strengths and times recommended above may be taken as applying in all cases of ordinary routine blood examination, such as the differential leucocyte count or the search for parasites. But if finer results are desired they may be obtained at the expense of rapidity by diluting the blue and eosin ten times and allowing them to operate each for about five minutes. Practice with the stains at these dilutions will reveal the exact times needed for the most beautiful pictures.

The most obvious advantages of the method are the simplicity of the stains used, the fact that they do not deteriorate by being kept and the great saving of time effected.

Manson's blue is readily made up and only improves by keeping. The whole staining operation does not take more than two minutes. Moreover, it is well under control, and a slight variation of the times given above may be made to produce a desired difference in the results.

THE STORY OF A TOOTH PLATE—AN UNUSUAL WAR INJURY.

BY MAJOR GORDON TAYLOR.

Royal Army Medical Corps.

Senior Assistant Surgeon to the Middlesex Hospital, &c.

DURING the Battle of the Somme a soldier was buried in his shelter by a large shell. He was dug out from amongst the debris in an unconscious state, and ultimately placed on a hospital barge and thus conveyed to the Base. When he recovered consciousness on the barge, one of his first requests was for the artificial tooth-plate which he had been wearing when he was rendered unconscious by the shell explosion, and which he now missed. The denture—an upper one—was produced from his wallet by the attendant orderly, but the patient, remarking its size and the number of teeth, quickly declared his doubt as to it being his, or if it were, he assured those in attendance that it must have been broken and that part of it was missing.

The patient had also shown some signs of a fracture of the skull, and to this was ascribed the difficulty in swallowing of which he complained. No radiogram was apparently taken, and he was speedily evacuated to England, and admitted into one of the Auxiliary Military Hospitals at Eastbourne. The man's story led to an investigation of the denture which showed clear evidence of having been fractured across its palatal and alveolar portions. Examination with the screen revealed the presence of a foreign body in the thorax, and an X-ray plate showed a denture with two teeth opposite the middle piece of the sternum.

I was hurriedly asked by the medical staff of the hospital to come down from London and try to remove it. The use of a Bruning's œsophagoscope fitted with a Hill's tube enabled one to obtain a good view of the offending denture, and it was easily extracted, *per vias naturales*, by means of an Irwin Moore's forceps. So far as his gullet was concerned, recovery was quite uneventful, but the original diagnosis of a fractured base of the skull was only too surely confirmed by the

development of a pulsating exophthalmos, which was successfully treated by ligature of the internal carotid artery by an able Eastbourne surgeon.

The case is of interest in that a fracture of an upper dental plate was produced without any injury of the superior maxilla. This injury is by no means unique, for I have heard of similar accidents in the present War, but the story of this particular case, where one of the fragments of the broken denture was actually swallowed by a patient rendered unconscious by the same injury that fractured the dental plate, must be almost without parallel.

Reviews.

MODERN MEDICINE AND SOME MODERN REMEDIES. By Thomas Bodley Scott. With a preface by the late Sir Lauder Brunton, Bart., F.R.S. London: H. K. Lewis and Co., Ltd. 7 x 4 $\frac{1}{2}$. Pp. xi and 169. 6s. net.

In daily life medicine still continues to be more of an Art than a Science, as accurate measurements are only applicable under certain limiting conditions, of which the training of the observer is not the least important. Accuracy of measurement is of course only relative; all scientific processes involve the passing of material through a series of sieves of increasing fineness of mesh, and if we are content to correlate the extent of our conclusions with the degree of coarseness of the mesh, we may still work in a truly scientific manner, and the work of the observer who is unable to apply exact methods may be of great value provided he recognizes his limitation—frames his working hypothesis accordingly and declines to extend his conclusions beyond the boundary that is justified by his method of working.

Further, the skilled observer notes, remembers, or better still, records the incommensurables, and uses this knowledge as a basis for further and more exact observation, as his method becomes more delicate and for future action where his intelligence (intuition if you will) suggests that the conditions are the same. This last—*empiricism*—is the art of medicine; no working hypothesis is involved beyond the postulate that things which are equal to the same thing are equal to one another.

The science of medicine has however developed so far that a third element is involved, the practical use in everyday work of the results of experimental work by trained observers, having opportunities for, and means of measurement.

This, at its best, is the same process as that by which the mechanical engineer reduces to practical working formulæ the rigid abstractions of the pure mathematician. This adjustment of experimental to practical conditions can hardly be carried out except by those who understand the principles which underlie the experimental work.

The intelligent general practitioner (the adjective would appear to be necessary) then makes use of three processes—two involving some reasoning, the third memory and the ability to recognize a previous combination.

The late Sir Lauder Brunton was a very great artist in medicine, and especially in the use of experimental work in everyday work. He was, moreover, a man of wide experience of the methods and actual work of his less distinguished brethren. His preface calls attention to the great waste of that knowledge acquired through many laborious years by the general practitioner in the course of his daily duties, a waste which has increased since the system of apprentice-

ship was discontinued. But if the general practitioner is to contribute anything of value, it can only be the result of systematic note-taking and periodic analysis and discussion of these notes; such analysis one sees only too rarely in the medical press. Sir James Mackenzie for one has shown how much can be done in the turmoil of a general practice; much of his work of course consisted of accurate measurements and deductions from them, but scattered through all his work is a mass of observation of unmeasured and immeasurable details—such as could be recorded and classified by any man in practice.

Dr. Scott's book is a very good example of what can be done by careful observation and the assimilation of the result of other men's experimental work. It is thoughtful, suggestive, delightfully written and of considerable value in the practice of the art of medicine. We need more books of this type. R. J. S. S.

MEMORANDA ON ARMY GENERAL HOSPITALS ADMINISTRATION BY VARIOUS AUTHORS. Edited by P. Mitchell, M.D. Aberd., Lieutenant-Colonel R.A.M.C.(T.), Commanding No. 43 General Hospital. Demy octavo, pp. vii and 109. Baillière, Tindall and Cox. 5s. net.

This is like a sheep's head, "fine confused feedin"—and full of interest—in parts. But although it cannot be considered a very important addition to one's knowledge of the subject with which it purports to deal, it contains many useful suggestions; others to which this adjective would hardly apply, as for instance that in ward dieting, "The system would be run entirely on trust as between the wards and the kitchen and the auditors would accept the sisters' summaries"; one only wishes they would.

Some of the matter deals less with a General hospital as such than with the Royal Army Medical Corps, Territorial Force.

One feels a little uncertain how far the various contributors have practical experience of at least a part of the subjects they deal with—on a good many points the reviewer would certainly not express agreement. R. J. S. S.

THE DRINK PROBLEM OF TO-DAY. Edited by T. N. Kelynack, M.D. London Methuen and Co., Ltd. 1916. 8 $\frac{3}{4}$ x 5 $\frac{1}{2}$. Pp. ix and 319. 7s. 6d. net.

This is a collection of essays by various writers on the 'ologies of Alcoholism; its relation to Law, Life Assurance, Women and Children, Crime, Poverty, National Efficiency, Work, War, Legislation, the development of National Sobriety, and the means of arresting Alcoholism.

It is not a book for specialists alone, but written so that any intelligent person may read and understand. It is probably not unfair to say that the physiological, pathological, and psychological results shown in the articles dealing with these sections are not always interpreted in the sense the various authors interpret them. The statistical argument is seen well in the articles on Alcoholism and Life Assurance, but the same argument against too forcible deduction applies here as in other cases where the question of protection arises, that the total abstainer is, on the whole, probably a person who in every way takes as few risks as possible.

It does not seem at all necessary to pursue investigation into the details of the whole relations of alcoholism so far as is often done; this not only confuses, but leads to over statement and controversy. The problem can be dealt with on much simpler lines. No one can affect to be ignorant of the hideous results of excess; on the other hand, no ordinary man will ever be convinced that the moderate use of alcohol produces any ill effects whatever. The whole difficulty lies in the term moderate, which is an indefinite and indefinable expression, as the quantity varies with the individual, his work and surroundings.

Since this book was written, many things have happened which throw some light on the question. There is the legislative control of opportunity and alcoholic content; the general movement, headed by the King, to abstinence or diminution

in consumption—the latter aided by increased cost, which in this instance can hardly be called an economic factor in the ordinary sense. Again, we have the "wastage" of food-stuffs for the production of alcoholic liquors against the demand of labour for a sufficient supply. Compulsion would not appear to be successful except under strict discipline, and it certainly does not affect the desire or habit when opportunity becomes available.

The tripod on which sobriety (not abstinence) will eventually stand is formed by education, control, and the café instead of the public house.

This volume gives a very fair and useful account of the whole problem from its various aspects.

THE CONTROL OF VENEREAL DISEASES. *Edinburgh Review*. April, 1916.

This is a very clear and concise Summary—for the general reader—of the main facts of this most important matter, a summary which is sufficiently impressive in its account of the terrible consequences of infection.

To us, with experience of the benefit of control at the source, it appears that the provisions suggested for the prevention of the spread of infection after it has taken place rather suggests locking the door after the horse has been stolen. This, however, is a very complicated question, and a quotation from the last paragraph of the first article in this number of the *Review*, "The Psychology of the English," is very much to the point. "It has been possible in England to defend the worst abuses in the sacred name of the individualism that was false because it meant the freedom of some individuals to flourish at the expense of other individuals."

One is glad to find that the Press (no doubt assuming that the *jeune fille* of to-day has either something else to think about or knows all that there needs to be known) has opened its columns to the public discussion of a matter which is at least as important as the arrest of tuberculosis. We probably have less of the Pharisee than we had "before the War," and with the increasing open influence of women, we may arrive at some mode of combating this scourge.

A GRAPHIC RECORD OF THE WORK OF A GONORRHOEA DIVISION. By Captain A. M. Davidson, R.A.M.C. (T.C.).

If one were asked what was likely to be the state of a section of a V. D. Hospital, in which 400 patients were under the care of one medical officer, three N.C.O.'s, and about three men, one would have no hesitation in answering "chaos," and be right in the majority of instances. A graphic record, which has been produced by Capt. A. M. Davidson, of the work of his division under the above conditions proves, however, that chaos is not by any means necessary. On the contrary, it is not only possible to carry out systematic treatment, but to compile records relating to gonorrhœa and its management, which are of the greatest value. The secret lies in the intelligent use of patients, as demonstrated in this record, which is a bound, type-written volume, dealing with details of administration in gonorrhœa, housing of patients, plans of treatment and their results, and numerous matters of clinical and statistical interest, illustrated by many photographs, paintings, plans, and charts. The book has been placed in the Royal Army Medical Corps Library, and should be consulted by all those interested in the organization of venereal treatment.

To mention a few of the main features of this work, the first chapter deals with accommodation of the patients in the section, and in housing of the treatment facilities. This is illustrated by a plan of the division, sketches and photographs of the treatment hut and acute-case tents, and a plan and elevation of a hip-bath house erected by the patients. Chapter II deals with establishment and its duties, the latter being set out in detail for each person concerned. The detail of the establishment is as mentioned in the paragraph above. Chapter III is

devoted to details of administration, such as admission of patients, bathing, disinfection of kit, etc., and procedure on discharge of a patient from hospital. Medical inspection of new admissions is dealt with in Chapter IV, which is illustrated by photos and paintings of interesting clinical conditions. Chapter V is devoted to the details of the irrigation treatment of gonorrhœa, and is illustrated by sketches of an irrigation trough (with dimensions), arrangement of an irrigation pail, showing height from the ground, an arrangement of the syphon, a standard colour of 1/8,000 permanganate, etc. Chapters VI and VII deal with the treatment by vaccine and by intramuscular injections of succinimide of mercury. The author's opinion is that neither of these is of any value, and he cites in support of his opinion a number of detailed statistics to be found in the appendix. The reviewer's criticism of these is that they relate to cases which were by no means under parallel conditions; the latter varied, in fact, so widely that considering the slight differences in the results, the various series are of no value for the institution of a comparison between any one treatment and another. The remaining chapters are devoted to the complications of gonorrhœa and their treatment, and are profusely illustrated. The appendix is occupied by numerous statistical tables and charts, and a chapter by Private L. Hulls, the laboratory chemist, on the chemistry of the mercurial compounds, which have been used in this hospital for the treatment of gonorrhœa. There is also an account of an experiment on a rather large scale to determine the value of purely medicinal as opposed to medicinal and local treatment of gonorrhœa. The experiment was carried out on 200 patients, and was abandoned after two months, when it became obvious that the purely medicinal treatment was a complete failure as compared with the irrigation treatment. The more serious sections of the book are relieved by the illustrations at its beginning and end, which must be seen to be appreciated.

The work, which was typed and largely illustrated by his patients, is a monument to the industry and powers of organization of its author.

Correspondence.

CIGARETTE SMOKING AND "NERVES."

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I was glad to see recent letters in the daily papers dealing with "nerves" due to too much tobacco.

It is not exaggerating to say that there are at the present moment thousands of officers and men in hospitals, convalescent hospitals, command depots and home battalions who are delaying their cure and preventing themselves from becoming fit for active service by excessive cigarette smoking.

I have been for twelve months on a travelling medical board examining on an average 1,000 men per week, and for five months I was inspector of civil hospitals and convalescent auxiliary hospitals in a large centre, so I am writing about what I know.

If anyone wishes to roughly test the truth of my assertion, let him look at the hands of the next ten patients he meets who have been a long time in hospital and who complain of nerves; he will find that their first and second fingers are stained dark brown with nicotine. This is the "outward and visible sign" of the excessive cigarette smoker.

The difficulty of dealing with the matter lies in the fact that smoking in moderation is not injurious to the majority of men who are in good health, and it is extremely agreeable; but in the interests of the country some vigorous action ought undoubtedly to be taken to discourage smoking by immature recruits, and by patients suffering from any form of heart trouble, general debility or nervousness—to these nicotine is poison. Medical men are well aware of this, but do not like to take a firm stand against the evil because it would make them unpopular.

What trainer would allow his pupils to smoke cigarettes, whether he was training them for boxing, football, racing or other form of contest necessitating a sound heart and good wind? Yet soldiers are not alone allowed, but encouraged by well-meaning associations and people who are continually supplying them with these aids to inefficiency either free or at a small cost.

To discourage smoking, I would suggest that a notice to the following effect should be posted up in every ward in all our hospitals, convalescent homes, command depots, and medical inspection rooms.

NOTICE.

When a man is not in perfect health smoking produces disorderly action of the heart and tends to make him nervous and shaky. It spoils his shooting and his wind, and he does not feel fit and vigorous.

For these reasons in their own interests, and in order to hasten their cure, men who are suffering from any form of heart trouble, general debility, or nervousness are forbidden to smoke.

BY ORDER.

A notice to this effect is being posted in every medical inspection room and in every ward in all military hospitals in the South of Ireland. I believe that the educational effect would be excellent, and that medical officers' hands would be strengthened in dealing with cases injuring themselves by too much smoking should the necessary authority be obtained for having these notices printed and posted in all British hospitals and medical inspection rooms.

The subject is certainly one for serious consideration as the quality of our man power is as important as the quantity.

I am, etc.,

G. J. STONEY ARCHER, *Lieutenant-Colonel R.A.M.C.,*
A.D.M.S., Cork District.

February 9, 1918.

Journal
of the
Royal Army Medical Corps.

Original Communications.

REPORT ON THE RESULTS OF THE BILHARZIA MISSION
IN EGYPT, 1915.

By R. T. LEIPER, M.D., D.Sc.

*Reader in Helminthology in the University of London; Helminthologist to the London
School of Tropical Medicine.*

(Continued from p. 190, vol. xxvii, 1916.)

PART V.—ADULTS AND OVA.

THE morphology of the adult worms, and of the eggs recovered from cases of bilharziosis in Egypt, has been dealt with exhaustively by several previous writers, notably by Bilharz, Leuckart, Fritsch, Lortet and Vailleton, and particularly by Looss.

VARIAIONS. In parasites generally there are certain small variations within the limits of a species both in size, shape, etc., of adults and of eggs. In *Bilharzia hæmatobia* unusually striking and constantly recurring departures from the normal have been described. In Looss' monograph on the adult anatomy it is recognized that a number of these do actually occur, but others are, in his opinion, due to errors in interpretation by previous workers. These abnormalities, rather than the normal anatomy, are our more immediate concern. The differences that have been recorded in the shape of the eggs are of special interest. As early as 1851 Bilharz had noticed that certain of these, passed in the *fæces*, were distorted, the small terminal spine of the typical egg being apparently displaced laterally. These lateral-spined eggs he regarded as abnormalities.

DUALITY
THEORY.

In 1864 Harley [214]¹ was so struck by the absence of these atypical forms in cases of bilharziosis seen in South Africa, that he named the South African parasite *Distoma*

¹ These numbers refer to titles in the Bibliography of Bilharziosis which accompanied the earlier sections of this Report.

capense, to distinguish it from the Egyptian parasite which gave rise to both types of eggs. The subject remained one of merely academic interest until 1902, when Sir Patrick Manson saw in London a case of intestinal bilharziosis, contracted in the West Indies, in which lateral-spined eggs only were present. In the following year he put forward the suggestion that: "Possibly there are two species of Bilharzia, one with lateral-spined ova, depositing its eggs in the rectum only, the other haunting bladder or rectum indifferently" [328]. This view was revitalized by Sambon in a series of papers, commencing with one in 1907, in which he formally named the new species after Sir Patrick Manson, "in appreciation of this, one of his many genial intuitions" [425, 426, 427, 428]. Sambon's new species met with an unsympathetic reception, more especially from Looss, who held, with many elaborate arguments, and with some apparent success, that vesical and intestinal lesions in bilharzian infections in Egypt were caused solely by the one species, *B. hæmatobia*. The whole controversy cannot be reviewed here, but the curious reader will find in the prolonged debate "a stimulating vituperativeness" which makes it highly entertaining, if somewhat cruel reading.

SAMBON'S
SPECIES. In his "Remarks on *Schistosomum mansoni*," Sambon [425] explained that his "determination is based principally

on the characters of the eggs," but that in addition, he had "taken into consideration their different geographical distribution, the different anatomical habitat, and the different pathogeny of the two species." He maintained that "the lateral-spined ova are not found occasionally only, within the distributional areas of *S. hæmatobium*, as would necessarily be the case if they were the product of this species, but have a peculiar and wide geographical distribution of their own, being absent in many places where endemic hæmaturia and its causative agent are prevalent (Cyprus, South Africa)."

LOOSS'
THEORY. The opposing theory put forward by Looss was, briefly, that "unfertilized females are not capable of producing other than abnormal eggs." These abnormal eggs were

for the most part the lateral-spined variety, and where they contained a miracidium this was attributed to parthenogenesis. Looss' position, which met with clever criticism from Sambon, became somewhat changed later in the light of his own further observations, but his main tenets remained, and his final ground became, theoretically, unassailable without the aid of experimental evidence.

LOOSS'
ARGUMENTS. In Looss' opinion "the strange and striking differences presented by the clinical and pathological pictures of bilharziosis as seen in various places" could be explained "on the presumptive life history of the parasite, in connexion with the habits of the host and the conditions of the country" [295].

Commencing with his postulate that infection is direct and takes place at all times through the skin, he maintained that the miracidia proceed to the

liver, where they develop into sporocysts, from which worms escape later into the portal veins. As at post-mortems it is not uncommon to find males, obviously of the same size and age, alone in the portal vein, he assumed that "they must have been generated at about the same time; this would become comprehensible on the assumption that they were generated in one sporocyst." The female worms which are less common likewise would originate from a sporocyst. Applying these postulates to the ordinary conditions found in the Delta, it appeared to Looss that "several miracidia penetrate the body at short intervals and thus males and females will be present." "In this case the females will not have long to wait for fertilization." While waiting they will have produced a few abnormal eggs but being almost immediately captured by the males are carried off to the pelvic organs, with the result that "there is urinary bilharziosis characterized by the apparition of terminal-spined eggs in the urine; the same eggs may appear in the fæces, but the lateral-spined ones will be so scarce that they seem to be altogether absent" [295].

In countries where conditions are unfavourable for infection, i.e., where the population is scattered and the people do not bathe in crowds, or where water is scanty or swiftly running, and the chances of miracidia entering the skin are small, then the following train of events may be presumed: "On a single occasion a few miracidia manage to enter the skin and one gets safely to the liver. It produces males. The worms grow to sexual maturity, but finding no females they wait for a certain time and then undertake the journey to the pelvic organs alone. The liver is again free from worms: the infection remains without consequences." This may recur as male producing miracidia are so common. Eventually a miracidium enters alone which gives rise to female worms. In due time these "begin to lay lateral-spined eggs. The oviposition goes on, perhaps, for a long time. The number of lateral-spined eggs increases steadily; all are carried to the liver." Some of these worms may migrate successfully as far as the large bowel.

Eventually there will be a "strong infection of the liver and some isolated patches in the wall of the intestine, but no terminal-spined ova will ever appear, nor will there be a regular infection of the bladder. After some time, the lateral-spined eggs of the liver begin to appear in the fæces, and they continue being voided in this way for several years."

Looss details other circumstances under which a secondary infection with terminal-spined eggs may be contracted by a case showing originally Manson's intestinal bilharziosis if a sufficient interval has lapsed between the entry of the two miracidia. Lastly, infection by a large number of miracidia at a single exposure would result in a pure case of "urinary bilharziosis" [295].

Looss concludes that, from his point of view, "no sharp line of demarcation between the two types" exists. "They are simply the opposite ends of a continuous series of intermediary stages" [295].

After detailed criticism of Sambon's arguments, Looss dismisses them with the conclusion that "in all the evidence there is not the slightest detail which would really point to the existence of a distinct species in the West Indies and certain parts of Africa." He adds that one of the fundamental facts on which his views rest is that in 1852 Bilharz actually found in Egypt that "the eggs of *S. hæmatobium* and *S. mansoni* may occur in one and the same individual."

Replying in 1909, Sambon [428] pertinently points out that Bilharz's alleged observation has never been confirmed and that the interpretation that both lateral-spined and terminal-spined eggs were actually seen in the same individual worm does not necessarily follow from Bilharz's statement. In turn he attacks Looss' hypothesis, especially his assumption of the occurrence of parthenogenesis in the adults.

The effectiveness of this criticism is revealed by the readjustment of his position by Looss in 1911 [298]. He now recognized that "the question of the formation of these eggs and the question of their fertilization are in reality independent." He is still of opinion that the uncopulated females are incapable of giving their eggs the normal shape. After fertilization the change to normal shape will not take place immediately; there will always be a transition period. There is thus no longer any necessity of admitting on the part of the egg cell a capability of developing "by parthenogenesis." "I have received the impression that when once the production of normal eggs begins, the others are, as a rule, quickly evacuated." "That the females of *S. hæmatobium* can, and do, produce the two forms of eggs is beyond question even now."

American parasitologists attempted to settle the controversy by suggesting that possibly the eggs of *S. mansoni* were normal eggs similar to the abnormal forms, with distorted spine, produced by *S. hæmatobium* [271].

Obviously the possibility that, in Egypt, man harboured two distinct species of bilharzia worm complicated the transmission problem, already rendered intricate by the presence there of bovine and avian infections.

It was realized, however, that the full solution was not an essential preliminary to the conduct of experiments which were more urgently needed to provide the necessary data on which to base prophylactic measures for the protection of the troops. The *Bilharzia cercariæ* found in *Bullinus* and in *Planorbis*, as well as other cercariæ, were found to react in practically identical manner to changes in their environment; whether these were physical, such as exposure to heat, drying, etc., or chemical, such as exposure to dilute amounts of sodium bisulphate, etc. The *B. cercariæ* showed the same limited capacity to survive in water and

caused local irritation due to penetration of the skin in animals exposed to infection by immersion. Thus the earlier parts of this report were written with reference to "bilharzia," without touching (save inadvertently by the use of "*B. hamatobia*" in the old inclusive sense) on the problem of the unity or duality of the parasite concerned in the causation of bilharziosis. Indeed, the success of these experiments led to a further delay. The lethal effect of very dilute solutions of coal tar derivatives on the cercariæ raised the hope that if minute quantities of these substances could be got into the portal system unchanged, they might be found to destroy the bilharzia worms there. Thus, by cutting short the egg-laying period, the subsequent severity and duration of an infection might be considerably diminished.

Surgeon-General Ford was of opinion that a satisfactory method of treatment might prove of considerable service. Expert co-operation in the pharmacological aspects of the problem was obviously desirable. As soon, therefore, as it was evident that animals were being infected successfully, I decided to infect as many animals as were then available and to return to England to carry on further work on these lines. Infections were accordingly made from *P. boissyi* and from *Bullinus*. It was hoped that these would provide material still needed for the zoological inquiries not yet completed. A return in the autumn was foreshadowed, if facilities were obtainable, in the event of the need arising for further investigations through failure of the material or the upcrop of new problems.

EXPERIMENTAL TREATMENT NEGATIVE.

Most of the infected animals survived the homeward journey. Dr. H. H. Dale, F.R.S., kindly carried out a series of tests and the animals were afterwards dissected. It was agreed that none of the substances of known anthelmintic or cercariacidal value could be introduced into the portal system in doses lethal to adult parasites. This cleared the ground for a continuation of study of the specific nature of the cercariæ found respectively in *Bullinus* and *Planorbis*.

THE CERCARIÆ IN *Planorbis* AND *Bullinus*.

In addition to the cercaria provisionally identified as that of an avian bilharzia worm, three bilharzia cercariæ were provisionally differentiated from material collected at El Marg (figs. 45, 46, 47, Part III). Of these, one (fig. 45) infested *P. boissyi*; with it, later, but seen much less frequently, was a large form (fig. 46). This mollusc was not found in some other villages where bilharziosis was also prevalent. It was, therefore, apparent that even if eventually it was proved to be a carrier of infection to man, other species of mollusca must also be concerned. The search was therefore continued, and several weeks later, at the commencement of June, examples of the genus *Bullinus* was found to be likewise infested with *Bilharzia cercariæ* of slightly different appearance (fig. 47). As cercariæ, naturally discharged, became available from each source, animals were submitted to infection by immersion, and later by the mouth.

The animals first submitted to infection died from blockage of vessels by the growing worms before these had attained their full size. Such hyperinfection was at first courted to establish the fact that the animals in experimental use were actually susceptible. Later this had to be avoided to ensure that the infected animals would survive sufficiently long to show the effect of drug treatment on the worms in the portal system, and to give the growing worms sufficient time to attain sexual maturity and produce eggs whereby the specific character of the infection could be finally identified. This proved a much more difficult task. Too slight an immersion might result in a failure to infect or a failure to infect with enough to ensure the presence of females as well as males. Mishaps from all these causes befell in the animals taken to England, and as will be seen, necessitated a return to Egypt for further material.

EARLY
APPEARANCE OF
LATERAL-SPINED
EGGS. Before leaving for London, two or three eggs only were seen. The first occurred in a female taken from the mesentery of a mouse that had survived until June 24. The others were seen a few days prior to sailing. These eggs were lateral-spined and were the result of infection with cercariæ from *P. boissyi*. According to Looss' theory these were the early abnormal products of young sexually mature females of *B. hæmatobia*; according to Sambon they should be regarded as characteristic ova of *B. mansoni*, the cause of intestinal bilharziosis; according to American parasitologists, they were merely early abnormal products of *B. hæmatobia*, simulating the true lateral-spined egg of *B. mansoni*, the cause of bilharziosis in the New World. Males were present as well as females, but this fact had now no significance, since Looss had himself abandoned the view that the females produced eggs parthenogenetically. The females found had only reached the egg-laying state. It was possible that they were just entering Looss' "transition period."

Sufficient time had not elapsed since the submission of animals to infection from *Bullinus* to warrant an examination of these prior to sailing.

After reaching London, in July, animals continued, as before, to die from hyperinfection with young adults. At the beginning of August, four monkeys which it had been hoped would survive several months, began to pass eggs and died within a fortnight of intense infection. These eggs were lateral-spined. The cercariæ used had been obtained from *P. boissyi*. No other type of egg was found. It could not be said, however, that the worms had become mature sufficiently long to have passed through Looss' "transition period."

LATER
RESULTS. Certain of the rats which had survived until September showed at post-mortem an extraordinary condition of the liver. This was enlarged and deeply pigmented with black amorphous granules. The surface was speckled with minute white spots. These were found to contain accumulations of lateral-spined eggs. The final peripheral veins were frequented by paired adult worms. The liver

from these cases was macerated and the eggs released in enormous numbers. Every described variation in size and shape of lateral-spined egg was then found, but no terminal-spined eggs were seen. These animals had been infected from *P. boissyi*.

It had proved impossible to obtain material of the occasional large cercaria in *P. boissyi* for experimental purposes, but it was anticipated that in the very large series of infections made with cercariæ from *P. boissyi* for the experiments with drugs this cercaria would give evidence of its presence. Neither in the eggs nor adults resulting, however, was any indication seen of another species. The nature of this large cercaria remained, therefore, a perplexing mystery.

FAILURE OF FIRST *Bullinus* EXPERIMENTS. During September the animals submitted to very slight infection were still alive and were anxiously watched for evidence of successful infection. No eggs were passed, and as the length of time that had now elapsed since immersion was considered sufficient to allow of the worms attaining sexual maturity, those treated with cercariæ from *Bullinus* were killed and examined. The results were disappointing. It was evident that in the attempt to infect so slightly as to ensure the survival of the animals for some months the number of cercariæ that had actually entered had not been sufficient to ensure successful infection with paired adults. This experiment was repeated with certain of the animals slightly infected with cercariæ from *P. boissyi*. No adult worms were found.

NEW EXPERIMENTS IN EGYPT SUCCESSFUL. Reviewing the position early in October, I realized that the materials now available were insufficient to enable me to deal effectively with the question of the zoological relationship of the bilharzia worms that caused the symptoms of vesical and intestinal bilharziosis. Certain facts might justify a reopening of the Sambon-Looss controversy, which had reached a position of stalemate, but they would not render the final position taken by Looss untenable. With the *B. cercariæ* available, it was clear that a complete solution was possible. The completion of this report was, therefore, postponed. I was granted permission to return to Egypt, and was enabled to do so by the Committee of the London School of Tropical Medicine, which allowed me to resume an unexpired portion of the Wandsworth Research Scholarship, which I had previously held.

Two series of experiments were seen to be required and were instigated immediately after I reached Egypt in November:—

(1) To lightly infect animals with *P. boissyi* cercariæ so that they would survive several months and thus enable the female bilharzia worms to pass the "transition period."

(2) To heavily infect animals with *Bullinus* cercariæ to ensure a successful diagnosis of the specific nature of this form. In view of the successful and heavy infections that had followed the administration of *P. boissyi* cercariæ by the mouth, it was decided to make the crucial experi-

ments by this method, which appeared to afford a more accurate means of control in the dosage. To ensure longevity monkeys were used. Additional experiments were made by immersing rats and mice in infective fluid, and other monkeys were subjected to skin infection.

These new experiments proved, after the necessary lapse of time, completely successful.

The smaller animals were killed week by week to watch the progress of the development. Worms were first recovered from a mouse, infected by immersion, on the seventeenth day. These were of course, very immature, but they showed differences in the development of the gut from those previously reared from *P. boissyi*. This difference persisted during the growth of the worms, as seen from later dissections, until the adult size was almost reached. The two lateral branches of the gut failed to unite early. In several of the experiments, males only were found. After five weeks, males and immature females were recovered from the mesenteric vessels of mice infected by immersion, but the numbers were small. A mouse, injected subcutaneously with cercariæ obtained from *B. dybowski*, by dissection showed eight adults, of which none were females, when killed thirty-seven days later. In this series, worms were found after the sixth, seventh and eighth week, but the females had not yet begun to lay eggs. On the ninth week, however, the production of eggs had commenced.

Turning to the series of infections by the mouth, the following contrast is interesting: Two Indian monkeys, taken to Egypt from London for the purpose of these experiments, were given infective fluid to drink on the same day. The female monkey received fluid containing cercariæ naturally discharged by *P. boissyi*; that administered to the male monkey contained cercariæ naturally discharged by *Bullinus*. The female monkey began to pass lateral-spined eggs in the fæces on the forty-second day, and died from bilharzial dysentery on the sixtieth day. The male monkey showed no eggs in fæces or urine on the forty-second day and was killed. Many male and female worms were found in the liver and mesenteric vessels, but no eggs were found either free or in the females.

In the worms recovered from these older infections from *Bullinus*, the lateral branches of the gut had now united, and a short cæcum was developing. The males showed a further point of difference from those found in infections by *P. boissyi*, viz., the testes were less numerous, numbering only four to five. As this number had been recorded for *S. hæmatobium*, and was found to occur normally in *B. bovis*, it was still impossible to say whether the *Bullinus* infection was due to the bovine or the human parasite, without the evidence provided by the eggs. A further monkey had meanwhile been infected from *Bullinus* by the mouth. This passed numerous eggs in the twelfth week, and died of intense intestinal bilharziosis five weeks later. No eggs were found in the urine nor were any found in scrapings of the bladder wall. The eggs were terminal-spined without exception and corresponded to those found in man, not those in

cattle. Female worms found post mortem contained the eggs in numbers. This result confirmed the earlier find in mice which had been infected by immersion. Other animals gave confirmatory evidence. We had now established experimentally that the cercaria derived from *P. boissyi* gave rise to lateral-spined eggs, whilst those derived from *Bullinus* gave rise solely to terminal-spined eggs. In both cases infection was restricted to the intestine, but this was probably due to differences in the venous connexions of the bladder. Undoubtedly the gut wall was the primitive habitat of all the bilharzia worms.

The young but sexually mature *B. hæmatobia*, derived from *Bullinus* infection, were well able to lay terminal-spined eggs. Although the very earliest efforts did not conform completely in full size and shape to the standard egg, no evidence of a tendency to the formation of eggs with laterally-distorted spine was forthcoming.

To completely clinch the matter, a final experiment seemed desirable. Animals—monkeys and rats—were infected very lightly with *P. boissyi* cercariae and kept alive for nine months. The living female worms, found post mortem at the end of that period were still producing lateral-spined eggs; one or two only at a time. For these coupled worms, the "transition period" must surely have long since passed.

The terminal-spined and lateral-spined eggs found in bilharzian infections are, therefore, the normal and characteristic products of two distinct species, *B. hæmatobia* and *B. mansoni*, and are spread by different intermediary hosts. The young females in each species produce slightly atypical eggs, but these slight variations do not "form a continuous series of intermediary stages between the two types."

As transmitter of the parasite of urinary bilharziosis in Egypt, *Bullinus* fulfils all requirements as far as distribution is concerned. It is found in the larger canals, in the smaller irrigation channels and finally, in the village ponds or "birkets." *B. hæmatobia* cercariae have been found in the species *B. contortus*, *B. dybowskii*, and once in a specimen which was recognized as *B. innesi*. These species would appear to correspond to the forms named *Physa alexandrina* by earlier workers.

The more restricted distribution of *Planorbis boissyi* would appear to correspond equally satisfactorily with the less universal occurrence of intestinal bilharziosis due to *B. mansoni* in Egypt. In the course of this inquiry, it was not found in the large canals or in the village "birkets." It appeared to frequent the smaller irrigation channels and drains where these were permanent. It was found also in marshes. Both carriers were found susceptible to drying, *Bullinus* extremely so.

The intermediate host of *B. bovis* remains to be discovered. This parasite was first found by Sonsino at Zagazig, some miles north of El Marg. Several animals were seen infected at the Cairo abattoir, but the majority of these came from the south. The veterinary inspector in charge informed us that *B. bovis* was much more common in Sudanese than in Egyptian cattle.

It may be that the large cercaria occasionally seen in *P. boissyi* at Marg is the infective stage, but of this there is no evidence save that no other Egyptian mammal is known to harbour Bilharzia.

At first it had occurred to me that these differences in size might be accounted for by the separation of the sexes in the bilharzia worms in contrast to the normal state of hermaphroditism prevailing among the Trematodes.

In his postulates Looss had argued in favour of sporocysts giving rise to adults of one sex only, to explain the frequent presence of males only in an infected person. This highly suggestive hypothesis may well prove true for the sporocysts and their resulting cercariæ in the molluscan host.

Experience shows that if the cercariæ discharged from one specimen only be used for experiment, the resulting worms may be of one sex only. Owing to the extreme fragility it was impossible to isolate a single "tube" of cercariæ from an infected liver and so put the matter to experimental proof. Experimentally infected animals, like naturally infected persons, usually show a marked predominance of male over female worms. This would seem to be a happy provision of nature to ensure that no female that had successfully gained her way into the final host should lack opportunity of producing offspring.

OTHER
PROBLEMS. There is one other matter relating to the bilharzia problem as presented by the village Marg which was for a long time puzzling, but for which a tentative explanation may be suggested. Urinary bilharziosis prevailed among the children in Marg to the extent of ninety per cent. The incidence of intestinal and particularly Manson's intestinal bilharziosis could not conveniently be ascertained. The presence there of infection with lateral-spined eggs was revealed by the find of specimens in the urine of one of the infected children. Now in the small canal within the confines of the village, *P. boissyi* was relatively more frequently infected with cercariæ, i.e., with *B. mansoni* than was *Bullinus* with *B. hæmatobia*. After many visits the habits of the residents became fairly well known. The shelving banks of the canal served as a public latrine. The sides and uncovered bed of the channel were strewn with faecal deposits. The Egyptian squatting for the purpose of defæcation faces the bank to observe anyone approaching. Consequently, any urine discharged falls on to the dry surface at a higher level than that at which the stool is deposited. This urine sinks into the dry soil leaving bilharzia eggs on or near the surface where they are exposed to the destructive effect of sun and wind. The eggs passed in the fæces are not so readily killed. It is well known that bilharzia eggs will remain alive and unhatched, in a fairly consistent stool, for weeks under suitable conditions. At Marg the level of the water in the canal rises and falls with a varying periodicity owing to the control in the amount of flow by the irrigation department. The consequence is that the sides of the canal, and especially the flatter portions of the bed, are automatically and

periodically washed. The bulk of the lateral-spined eggs will be set free and will rapidly hatch in the immediate vicinity of the proper intermediary *P. boissyi*. The terminal-spined eggs which hatch are only those that have been passed in the fæces, and to this limited extent the *Bullinus* snails will become infected. Within the village the stream is too shallow for bathing. In the summer the children proceed higher upstream and to the parent canal where *Bullinus* is unaccompanied by *P. boissyi*. It does not necessarily follow, therefore, that the incidence of bilharzial dysentery and hæmaturia due to *B. mansoni* and *B. hæmatobia* respectively should correspond to the incidence of infection in the respective intermediary hosts within the village. Unfiltered water for all uses is taken from this stream into every house in Marg, so that the chances of infection within the home seem very great, both from the use of the water for drinking and for washing. Practically nothing appears to be known of the prevalence of intestinal bilharziosis, especially among women.

<p>BILHARZ'S "FUNDAMENTAL" OBSERVATION: SUGGESTED EXPLANATION.</p>	<p>Before leaving the Sambon-Looss controversy, I have necessarily to deal with Bilharz's original observation [27], as Looss regarded this find of lateral-spined and terminal-spined eggs in the same female as one of the fundamental facts on which his own view rested.</p>
--	--

When first seen by Bilharz the lateral-spined egg was an enigmatical body. It was first thought to be possibly a kind of pupa; only later did Bilharz conclude that it was definitely egg. Bilharz's find of this peculiar body within the female is recorded, as translated by Looss, thus: "such a body was, though once only, but quite undoubtedly, found in the uterus of a female worm, the posterior part of which contained the normal ova."

Sambon contends that Bilharz did not here actually refer to a lateral-spined egg, but to a pigmented body and that "he only says that a peculiar brownish yellow body, furnished with a lateral spine was found only once within the oviduct of a female worm, the posterior part of which contained the ordinary ova." There is no clear indication, according to Sambon, that the ordinary ova were terminal-spined ova or that the point of his remarks had reference to the position of the spine, rather than to the dark yellowish discoloration.

To this objection Looss replies later by quoting a further statement by Bilharz: "Strange to say, the eggs appear under two different forms. The two forms were found within the oviduct of the mother as well as in the tissues of various abdominal organs of man."

The latter quotation to my mind brings no support to the contention that Bilharz found the two types within the same individual worm. Here he apparently wishes to convey that the shape of the egg was already determined before the egg left the female and was not a result of distortion in passage through the tissues—a view that has been held later by others.

On the other hand, having read carefully the original text, I am fully

convinced by its context that Bilharz really believed that he had seen the two types in the female, when he wrote the first statement, and that the shape of the egg, not its colour, was what he wished to bring under notice. Earlier in the same paper he describes the normal ova as terminal-spined.

An even more important paragraph in this paper has not been utilized by Dr. Sambon. Bilharz states that this body occurred in one of the first females that he examined. A drawing was made at the time, but no importance was then attached to the observation. A similar condition had not been met with again. Now it seems legitimate to infer that an observation made at the commencement of the research might not have the accuracy or detail of later results when more material was available. The

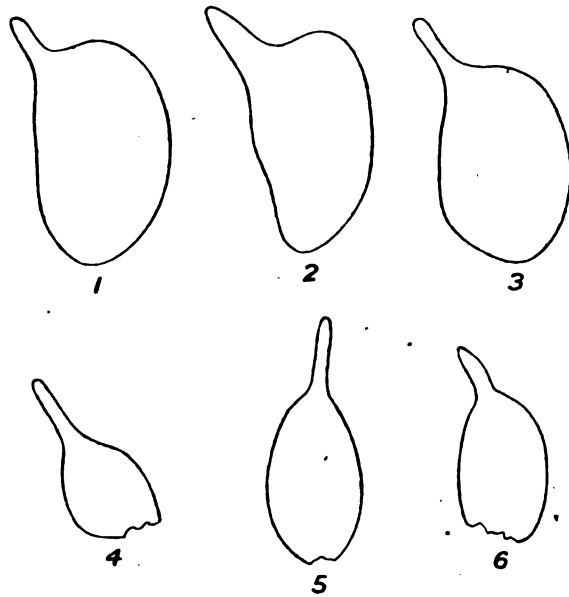


FIG. 1.—A series of eggs (1 to 6) found within the uterus of the same female Bilharzia.
(*Journal of Tropical Medicine and Hygiene*, 1911, p. 120.)

eggs with lateral spine are very striking objects, even when seen through the body of the females, but the ordinary ova observed by Bilharz may have been only apparently terminal-spined. My own suggestion is that Bilharz met with one of those females seen occasionally in which egg-laying has only just commenced. I have figured a series of eggs from one such female in the *Journal of Tropical Medicine* for 1911 [271]. The outlines are reproduced here. The first-formed egg (1) is lateral-spined, and lay just within the vulvar opening. The others (2 to 6) lay one behind the other towards the ootype, (6) having just passed from the ootype. All the eggs were rolled to show the greatest amount of lateral displacement of the spine. The later samples, it will be noticed, were incomplete and did not contain an ovum. These were, in fact, casts of the ootype in egg-shell

without normal content. If Bilharz met with a female similar to this one at the commencement of his investigations, he might well have concluded that the worm contained both types of egg.

When these sketches were made, I thought they might give support to the view put forward by Ward that the terminal-spined type of worm produced at first abnormal eggs with a sort of lateral spine; not identical with the lateral-spined egg of the New World.

On this interpretation the female was actually in Looss' "transition period," but the formation of standard terminal-spined eggs had not been reached. I now believe that the female was one just commencing to lay; that ovulation had not fully set in; and that after producing one or two complete eggs a number of casts of the ootype in egg-shell were thrown off. I have since met with similar abnormal lateral-spined eggs in the material obtained by maceration of the liver of animals experimentally infected with *S. mansoni* in Egypt.

OTHER MODES OF INFECTION. Among South African tribes there is a widespread belief that the cause of hæmaturia there, which we know to be bilharzia, enters the body through the orifice of the penis during bathing.

To prevent this certain races, such as Zulus, wear a basket-like protection. Pfister [323] has shown that a similar belief and a like form of protection prevailed among the ancient Egyptians. Its mode of use is to this day figured on the walls of some of the ancient temples of Egypt.

The belief, so far as I am aware, is no longer current among the native populace in Egypt. It has however spread in South Africa among the white population although the protective measures do not seem to be in vogue with them. The matter is of interest here because, as I am told, troops proceeding to Egypt were instructed that they could avoid bilharzia infection while bathing in the canals there, if they took the precaution of wearing the European equivalent of this ancient speciality.

During the field work in Egypt certain observations seemed to afford a rational basis for this ancient belief. Often one found small and very agile leeches on the nets and collecting gear. These were indeed a great pest for unless they were carefully excluded from the aquaria they rapidly destroyed the molluscs. Now I have heard of one or two cases where such a small leech entered the penis during bathing, and, lodging in the urethra, gave rise to profuse bleeding. This I believe is the probable origin of the association of a penile ingress with bilharzial hæmaturia and in so far as these penile sheaths have proved efficacious this is probably due to the exclusion of leeches.

In this report it has been shown that infection through the mouth is readily induced experimentally. As the acidity of the stomach destroys the cercariæ, it has since been argued that such experiments are of little practical significance, giving merely an extension of the area of skin infection. I am personally inclined to attach much more importance to this

demonstration of mucous membrane invasion ; more especially as it brings me into line with the conclusions of Day. This distinguished observer came to the conclusion from a close study of the conditions of infection in Egypt that the nasal and oral ablutions, carried out as a part of religious ceremony, played no small part in the repeated infections with bilharzia seen in the Egyptians, more especially of male sex. One of the most heavily infected sites in Marg was at the water's edge immediately in front of the local praying ground upstream of the village.

From the established facts regarding the mode of spread and of infection it is evident that troops deriving their water supply for all purposes from the large public water-works run no risk of infection, even though the washing places become accidentally contaminated with urine containing bilharzia eggs. The risks were among those stationed in small parties on the various bridges, roads and canal crossings throughout the Delta and among the troops occupying new camps on the fresh water canal, in the Fayum and elsewhere. Although supplied with pure water for drinking purposes, this had often necessarily to be supplemented by local supplies for general purposes. At one such place it was pointed out to me that the daily ration of water could be supplemented with ease "from a wee bit burn" which seemed to be of clear good water. A brief examination showed however that there were many *Bullinus* in this stream, which was simply an irrigation channel derived from a main canal on which was a large native population a mile or two inland.

Asked on one occasion what I thought were the risks from uncontrolled access to canals in the neighbourhood of camps during the summer I put down a conservative estimate of ten per cent. It is therefore of interest, and indicative of the value of the propaganda and prophylactic measures afterwards undertaken, that in two squadrons stationed at one of these camps during the summer of 1915 no less than twenty-seven, i.e., about twelve per cent strength contracted bilharziosis.

With the information at the disposal of the troops bilharziosis should now be treated as one of those diseases for which the individual is mainly, if not entirely, personally responsible.

MORPHOLOGICAL DIFFERENCES BETWEEN THE TWO EGYPTIAN SPECIES.

After the publication of *B. mansoni* as a distinct species in 1911, several American workers made a study of the anatomy of adult worms collected in the West Indies, Panama and Brazil, in search for morphological characters by which the species with lateral-spined egg could be distinguished from the terminal-spined form found in the Old World.

Comparing their finds with the formal descriptions given by Looss and others, they noted and briefly described the following peculiarities.

Holcomb [233] found that the adults of *B. mansoni* had a brown colour and a somewhat larger ventral sucker. Piraja da Silva [444] was struck by

the unusual appearance of the anterior end of the male worm which differed in outline from that figured, after Looss, as characteristic of the Egyptian worm in most text-books. The female appeared to taper towards the posterior extremity instead of ending abruptly. The cæcum approached the end of the body more closely. The oviduct united immediately with the vitelline duct instead of passing forwards to fuse with it at the ootype. The spinous papillæ did not seem so salient.

Flu [172] saw differences in the manner in which the anterior edges of the lateral walls of the gynæcophoric canal joined the body in the male and in the female in the presence of a coiled ovary in full grown specimens.

A further point of apparent differential importance was noted by myself in 1908 as a result of an examination of a batch of male bilharzia worms, collected at post-mortem by the late Dr. Turner, from cases of mixed infections in natives of Portuguese East Africa and Nyasaland. I quote the following interesting portion from my half-yearly report to the Colonial Office in May, 1908. "In cases of mixed infections (as ascertained by microscopical examination of bladder and rectal walls) I have been able to separate into two groups males having four somewhat angular large testes and males having seven to nine small spherical testes. In other cases all the males obtained belonged to one type. The difference in character and especially in number of testes would be considered as a specific character of some reliability if occurring in other groups and if constant as it seems to be here. In order that this character can be utilized in support of the view that the two forms of bilharziosis, rectal and urinary, are caused by parasites specifically distinct, it remains to be shown that males having one particular type of testes are usually or always in sexual conjunction with females producing one type of egg.

"Granted for the moment that these types of testes and of egg be found to occur constantly, the probabilities are that the male with four testes is the mate of the female giving rise to terminal-spined egg; for this is the normal arrangement of testes figured by Looss and the terminal-spined ovum is the one recognized by him as the normal product of the mate of this form.

"In support of this view, I am able at present to offer only one actual observation, in itself a striking one, owing to the lack of females in my material. In the one specimen of a paired couple in my possession, the testes can easily be made out to be seven. The female lies in the gynæcophoric canal, but its posterior half is broken off. Lying also in the canal, however, is a small 'clot' containing several lateral-spined ova. We have, then, evidence of the association of the multitesticular male with the female having lateral-spined eggs."

Replying to the points of difference as set out by Piraja da Silva, Flu, etc., Looss [300] maintained that these features were to be seen equally in specimens of *B. hæmatobia* in Egypt, and that they might be explained at least in part by varying degrees of contraction in the preserved worms.

As the chief monographs on the anatomy of the adult bilharzia worms were based on materials collected in Egypt, such material quite probably came from mixed infections. A comparison of the anatomy of adults of *B. mansoni* from uncomplicated cases in the New World with these published descriptions of *B. hæmatobia* was not likely to lead to acceptable conclusions.

It is evident then that a final settlement of the specific differences between the adult worms of *B. hæmatobia* and *B. mansoni* must be based upon a comparison of specimens taken from cases of unmixed infection and preferably from cases in South Africa and the West Indies respectively, where such infections occur.

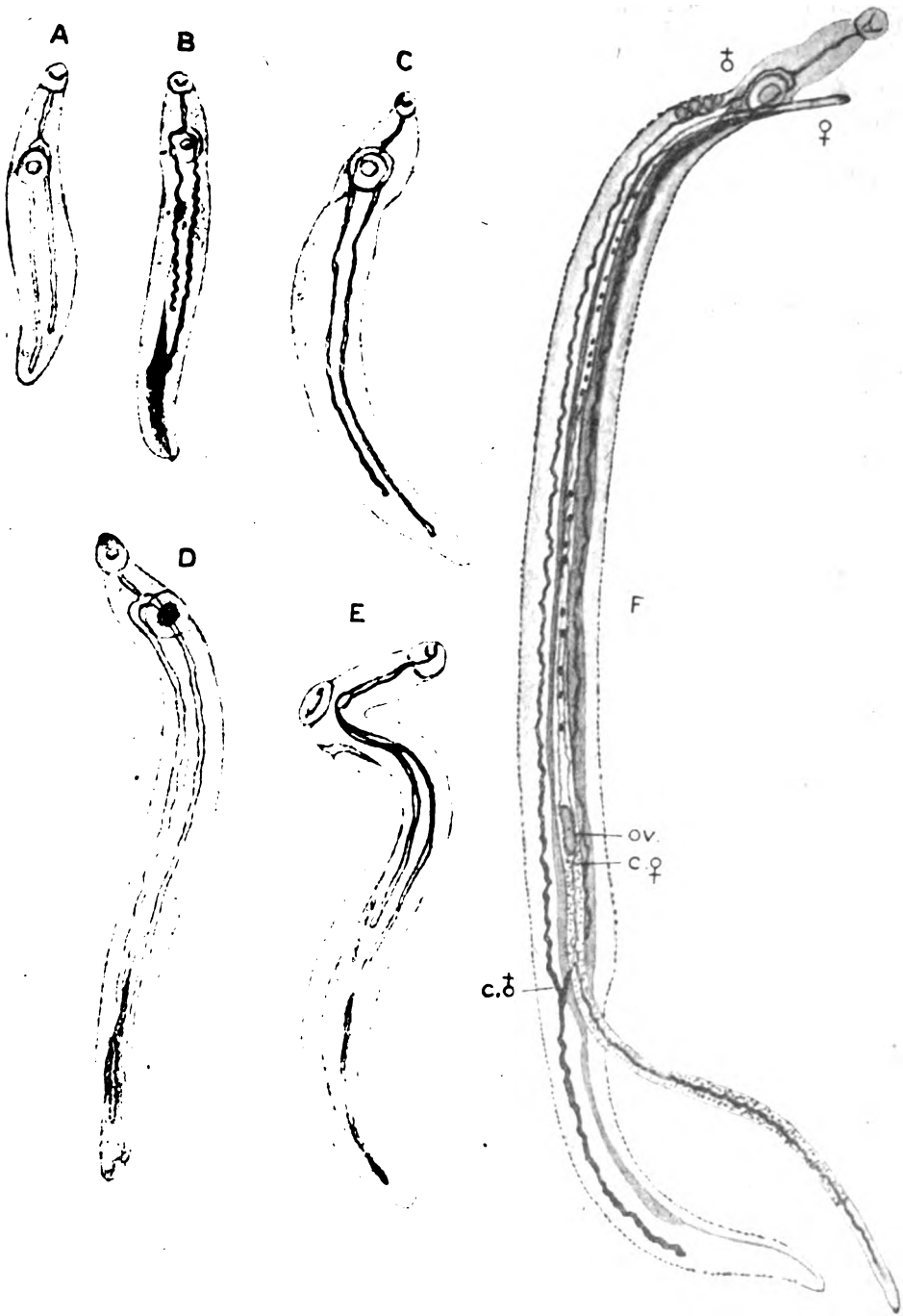
The bilharzia worms that have been reared experimentally from *Bullinus* and *Planorbis*, unfortunately, do not attain in the laboratory animals the full growth met with in their natural hosts. Although sexually mature and actually producing eggs, the worms are still young and small. Differential characters based upon measurements are likely to be fallacious under these circumstances. Morphological differences, may, however, be relied on; especially where these can be verified by reference to full grown adults taken from the human body in unmixed cases of vesical and intestinal bilharziosis. Unfortunately, an opportunity of obtaining such material has not been forthcoming hitherto. The following account of the differential characters as seen in experimentally reared worms must be regarded as a purely tentative attempt to differentiate the two species. It will be noticed, however, that it gains some extraneous support in the observations on the anatomy of *B. mansoni* quoted above.

In the males reared from *Bullinus*, the testes appear to number four or five almost constantly. They are also of fairly large size.

In males reared from *Planorbis*, the testes number seven to nine, and appear to be relatively small. Differences between the two sets of males are noticeable in the shape of the anterior portion bearing the suckers, and the relative size of the suckers is probably also to be regarded as of specific account.

In females reared from *Bullinus*, the eggs are constantly terminal-spined, even in small young females. The ovary is smooth and situated near the middle of the body. The lateral branches of the gut are lengthy and the cæcum correspondingly short. With this the range of the yolk glands which surround the cæcum throughout its length is apparently short.

In females reared from *Planorbis boissyi* the eggs are constantly lateral-spined. Usually one, seldom two, and very rarely, four eggs, occur in the uterus at one time. This is due to the short length of the duct. The lateral branches of the gut unite early, and there is a very long cæcum. The yolk glands surrounding the cæcum have, therefore, a correspondingly long range. The ovary lying in the fork made by the union of the gut branches is elongated and is within a short distance of the uterine pore.



Bilharzia haematobia (s. str.), developed from cercariae discharged by *Bullinus* spp.

A—E = Immature stages from liver showing delayed union of gut.

F = Adults in copula from mesenteric vein, showing short caecum and corresponding changes.

ov. = Ovary.

c. = Commencement of caecum.

The difference in the point of union of the lateral branches of the gut in the two species is common to male and female. It is a very noticeable feature in the growing worms. The posterior portion of the young worm would seem to be a growing tissue, which, by its continued lengthening, changes the relative measurements of the various parts of the gut almost until maturity is attained.

The attainment of egg-production is more rapid in *B. mansoni* than in *B. hæmatobia*. In experimental infections from *P. boissyi* eggs were found after six to eight weeks, from *Bullinus* after nine to twelve weeks, depending on the intensity of infection and on the host.

The developing worms and coupled adults reared from *Bullinus* infections are illustrated in figure on p. 251.

The question of nomenclature remains now to be NOMENCLATURE. reconsidered in the light of the foregoing results. The generic name *Bilharzia*, proposed first by Cobbold [92], gained almost universal acceptance, especially in medical works and in contributions on the clinical and pathological aspects of infection. I have used the name *Bilharzia* in the present report, as it is the one by which the disease is commonly diagnosed. Within recent years, however, the name *Schistosoma*, given by Weinland [515], in 1858, has been revived under the present operation of the Laws of Nomenclature. It is the more correct, although Cobbold states that under the laws in use at the time, Weinland accepted the priority of *Bilharzia* over *Schistosoma*. If the former generic term is used, the species should read, *Bilharzia hæmatobia*, and if the latter *Schistosoma hæmatobium*. It is to be hoped that on grounds of use and suitability, the specific names of *Bilharzia hæmatobia* and *Bilharzia mansoni* may retain their present application. Doubtless some day, it will, however, be noticed that the *Distomum hæmatobium* originally named by Bilharz, was based upon mixed material, and is, therefore, a composite species. Harley, the first reviser of the species, split this *D. hæmatobium* into two components. To the species giving solely terminal-spined eggs, he gave the name *D. capense*, restricting the name *D. hæmatobium* to that form found in Egypt which produced both kinds of eggs. I foresee that the name *B. hæmatobia* may thus be reserved by purists in nomenclature to the single specimen described by Bilharz, which conforms with these requirements.

There finally remains the *Bilharzia magna* found by Cobbold in a monkey. The type and only specimen, is preserved in the Hunterian Museum. It is a fragment of a male. I have been quite unable to identify it with either of the species now recognized in man. This is a happy circumstance, for we may now without anxiety retain the specific name of *B. mansoni* (with which the whole species problem has been indissolubly connected), in its rightful place to recall for future students the insight of one who took no part in controversy, but silently worked through others less inspired, for the eradication of many of the great pests of the Tropics.

**MOLLUSCAN
NOMENCLATURE.**

Throughout this report the naming of the various fresh-water molluscs is based upon Pallary's monograph. It has not seemed desirable to attempt to determine to what extent the various specific names of the genus *Bullinus*, such as *B. contortus*, *dybowski*, *alexandrinus*, *innesi*, etc., are synonyms of one another or of the names *brocchi*, etc., used by Jickeli and older workers. The name *Bullinus* is itself subject to controversy. Sowerby, Fischer and others use the older spelling *Bulinus*, while some are inclined to adopt a more recent synonym *Isidora*. By keeping to that of the most recent and best illustrated paper on the subject, which, moreover, is published in Egypt, we have avoided introducing confusion for local workers who may be interested more especially in the public health side of the question.

**PART VI.—BEARING OF PREVIOUS WORK ON *B. JAPONICA* AND
CONCLUDING REMARKS.**

Given the premises laid down by Looss as a result of prolonged study of local conditions in Egypt, his theory, "based upon a large number of anatomo-pathological and helminthological facts deliberately weighed and compared," could not be overthrown simply by an argument from analogy. If it were otherwise, those who accepted and supported his views bear a heavy responsibility for failing to apply the analogies resulting from the experimental data afforded by experiments with *B. japonica*; the first and most fundamental of which, made by Fujinami and Nakamura in 1908, excluded, for this allied species, the possibility of direct transmission.

In the opening section of this report, I have traced the evolution of scientific opinion regarding the mode of spread of *Bilharzia hæmatobia*. The analogies presented by *B. japonica* have there been referred to only to show how these were definitely set aside by the exponents of the theory of direct infection in Egypt. I have refrained from using them as an *a priori* argument, because in the proved facts of the life cycle of another common Egyptian parasite of man there was a strong opposing analogy, in support of the possibility of an exceptional occurrence of direct infection among parasites requiring usually an intermediate host. *Hymenolepis nana* has been shown experimentally to be capable of direct transmission although the other members of the genus have arthropod intermediaries.

Moreover, the object of my own work has been to arrive at a solution of the various problems, presented by the bilharzial diseases in Egypt, by direct observation and experiment, rather than by the inductive method.

I propose to relate now the various published facts concerning the life-history of *B. japonica* that were available at the outbreak of war; to show in what respects these failed to afford the data necessary for a rapid solution of the bilharzia problem in Egypt and in what way my own investigations on this Oriental species, while confirming previous conclusions of Japanese observers, gave a new method by which the infective

stage could be quickly and accurately delimited in the molluscs of a heavily infected locality. By its use the peculiar difficulties which have so long beset the bilharzia problem in Egypt were speedily overcome.

Before dealing with these investigations, I must recall that the problem of the bilharzia worms was not one of a peculiar and new type of larval development. It concerned rather the seat of this development and the exact route by which reinfection of man took place.

Holders of the theory of direct transmission were in agreement with their opponents that the larval metamorphosis of the bilharzia worms conformed, in all essentials, to that of other digenetic trematodes. Thus Looss, in 1908, wrote: "The existence of these (germinal) cells in the bilharzia miracidium is absolute evidence that the miracidium cannot develop directly into an adult worm, but must pass through the stage of the sporocyst which in its turn produces, either and probably at once, or by one or more intermediate generations, the definite worms."

The fundamental problems for each species of bilharzia worm were these: (1) Did the species follow its typical larval development in the liver of man or of a mollusc? (2) Did infection take place through the skin or by the mouth? (3) If a mollusc was an essential intermediary, what were the species concerned in the transmission of each species of worm? As regards the *B. japonica*, the first and second of these problems were, to my mind, conclusively settled by the researches of Fujinami and Nakamura in 1908.

In those regions in the Far East where man is infected with *B. japonica*, infections also occur naturally in cattle, cats and dogs. Using these animals therefore, as tests and controls, the following experiments were made. In the first investigation numerous miracidia were hatched in water. Dogs were then immersed in this. No results followed. In the second series, cattle, cats and dogs were submitted to possible infection by immersion in rice-fields and neighbouring ditches and streams reputed to be sources of infection. Intense infections with *B. japonica* ensued.

In 1910 other animals, not found naturally infected, were proved susceptible by experimental immersion, viz., mice, white rats, guinea-pigs, rabbits and monkeys.

In these experiments, described by Fujinami in a paper issued from the Internationale Hygiene Ausstellung in Dresden, in 1911, young parasites only 0.15 millimetre long were found in the portal system on the third day after immersion.

In 1911 Miyagawa described the invasion forms, as seen in the peripheral vessels and cutaneous tissues in two to twenty-four hours after immersion. These forms were smaller than those seen by Fujinami but differed in no essential respect. Oral and ventral suckers and a gut were already present.

In 1913 Miyairi, by experimentally infecting local molluscs with miracidia, found a sporocyst in an unidentified snail, stated to be a

Lymnæus, as Katsurada announced in a footnote to an article on "Schistosomiasis japonica," in December (*cf.* Bkt. 72, p. 378). Miyairi's original publication is in Japanese, but Kumagawa gave a summary of the chief points in an abstract published in the *Tropical Diseases Bulletin*,¹ in March, 1914.

"They noticed also that in the infested locality there are many snails in the waterways and ditches. Of these snails a great many *Cercariæ* parasitize one which has a dark coloured shell with seven spirals. The authors carefully picked up a number of young non-infected snails and tried whether the miracidia entered their bodies or not. They found that the miracidium enters the body of the snail, penetrating the cuticle with the lips and proceeds to the gills and the wall of the digestive canal. After twelve days the first rediæ appear and gradually concentrate to the hepatic ducts, elongating, and a number of the second rediæ are seen. The authors put mice into the vessel in which the full grown snails were fed, for three hours every day and repeated this experiment for four days. After three weeks they found a great many *Schistosoma japonicum* in the livers of the mice. The authors conclude that this kind of snail is an intermediate host of *S. japonicum*."

Judging by titles, other papers appeared in Japanese journals, but these are inaccessible. During 1914, Katsurada (according to an Italian abstract) "confirms the assertion of Miyairi and Sudzuki, but regards the question of the intermediate host of *S. japonicum* as not altogether cleared up."

It is evident that the above information, while definitely establishing a molluscan intermediary for *B. japonica* was of little value as a guide to the elucidation of the special problems surrounding the *B. hamatobia* transmission, and gave no facts regarding the bionomics of the infective stage, or of the carrier, upon which to base prophylactic measures. In Egypt all attempts to advance by infecting with the miracidia had failed, even in Looss' skilled hands. Sonsino and others had found no means of identifying the *B. cercaria* among the numerous developmental stages found in the snails of the endemic area in Egypt. There was not available for experimental purposes any animal of known susceptibility but man. Lastly, there still remained no explanation of the frequency of bilharziosis amongst very young children in Cairo.

In an article published in Mense's *Handbuch* in 1914, Looss admitted when dealing with *B. japonica*, that after Miyagawa's experiments the existence in this species of a free swimming cercaria was quite plausible. Under *B. hamatobia*, however, he states that if it is correct that there is an intermediate host in the Oriental species, "then *B. japonica* must differ essentially in its development from *B. hamatobia*." That Looss' view was still maintained by others is shown by the advice tendered to the

¹ Full titles and abstracts of the preceding and of all available publications on *B. japonica* are to be found in the volumes of the *Tropical Diseases Bulletin*.

Army in Egypt for dealing with an outbreak of bilharziosis amongst the troops stationed at Kasr Nil Barracks during 1912. In an article in 1915 by another authority in Egypt the following occurs: "Any small puddle or hole may become defiled, and in a very short time, the water or mud is alive with miracidia, which may become applied to the bare feet, arms or hands, penetrate the skin directly and so lead to infection." "Certain evidence we have none nor has any intermediate host ever been discovered."

Reviewing the bilharzia problem in the Spring of 1912, in the light of Fujinami's experiments and the repeated failures to infect monkeys and other animals with the miracidia of *B. hamatobia*, I concluded that the time had come to renew the attempt made by earlier workers to establish a molluscan transmission for this parasite.

In view, however, of the lack of success which had attended the previous efforts of Sonsino, Lortet and Vailleton, and others to follow the miracidia, a new method of approach seemed called for.

The occurrence of *Bilharzia magna* in *Cercocebus fuliginosus* rendered it not improbable that by subjecting monkeys of this species to immersion in water containing the various cercariæ, found in the endemic area, a positive result might eventuate. As *B. hamatobia* occupied a peculiar habitat in man and did not naturally infect any other animals a negative result might follow. In any case such an empirical method would obviously involve the purchase, transport and maintenance of a large number of monkeys or necessitate an unusually prolonged investigation, for which the necessary financial support was not likely to be forthcoming.

The experiments of Fujinami and Miyagawa appeared to me to open up a possibility that a morphological clue might be established by which the bulk of cercariæ of unknown origin could be excluded microscopically; thus bringing the experimental use of monkeys within practical limits.

Was there any outstanding feature which distinguished the adult distomes from the adult bilharzia worms and which had, in all likelihood, persisted from the sexless cercarial stage? In the cercaria there are organs, like the tail, which are purely larval structures, and others, like the suckers and the gut, which persist from the body of the cercaria through adult life. In some cercariæ, however, the gut has not yet formed although there is an oral sucker.

The suckers are, both as regards structure and position, very similar in distomes and bilharzias. The alimentary canal is, on the other hand, markedly different. The bulk of the distomes have a separate muscular pharynx. There is no pharynx in the bilharzia worms.

If this distinction were one which persisted from the cercarial stage then it afforded an easily determined morphological clue by which one could immediately exclude the vast majority of cercariæ, which are distomes.

It might be that the pharynx, originally separate, became fused with

the oral sucker in the adult as occurs in the amphistomes. Without definite evidence it was, therefore, impossible to come to a trustworthy conclusion regarding the absence of a pharynx in the cercaria of bilharzia.

Happily such evidence was now procurable as a result of the discovery of the "invasion forms" of *B. japonica* by Fujinami and Miyagawa. From the description of these bodies, which were said to possess oral and ventral suckers and a developed gut, it was evident that they were infecting cercariæ, but there was no mention, in either paper, of the presence or absence of a pharynx.

It was obviously necessary to establish this point by actual observation, not merely by inference, if it was to be utilized as a basis for experimental work.

My plan then was, in 1912, to proceed to Japan, and by repeating the original experiments or by examining the original preparations to settle this question; to confirm the expected value of the clue by examining the molluscs of the district where Fujinami has conducted his immersions and which was known to be intensely infected; and thence to proceed to Africa. If one or more of the molluscs there was found to contain cercariæ exhibiting this peculiarity, then it would be possible to attempt the experimental transmission of bilharzia to monkeys with every prospect of success.

These plans were, however, subject to other counsels and it was not until the summer of 1914 that I felt free to carry out my original scheme. This I was then enabled to do fully, thanks to the cordial co-operation of Professor Fujinami. Through him I was able to examine the "invasion forms" and to establish the value of my morphological clue by a visit to the rice fields of Katayama, where the ease with which the test could be applied to the molluscs in an endemic area was quickly demonstrated. With cercariæ exhibiting this morphological peculiarity, mice were afterwards infected successfully with *B. japonica*.

In the meantime, however, Miyairi and Sudzuki, as related above, had succeeded by another method of approach in tracing the metamorphosis in a closely allied, if not identical, snail, in the South Island of Japan. My own observations therefore confirmed generally the results of these workers, apart from establishing my chief, ulterior object; which was to provide a simple and reliable means of attacking the complex problems of *B. hæmatobia*.

In regard to details, concerning which only the abstract by Kumagawa was available, I was unable to confirm the presence of "redixæ" in the development of *B. japonica*. From my own observations I had concluded that the *B. cercaria* originate in sporocysts. I was not in a position, pending fuller information, to decide whether these "redixæ" were actually developmental stages of bilharzia or of some other species with which the

snails, experimentally infected with miracidia, had been naturally infected previously.¹

On my return voyage, after the outbreak of war, I visited Egypt and found that though the results of the recent work on *B. japonica* were known there, it was still held that they gave no solution to the special problems presented by the *B. hæmatobia*.

Considering that the new facts derived from my own observations on *B. japonica* would enable me to overcome the experimental difficulties which had hitherto surrounded the Egyptian question and realizing the immediate importance of some simple and efficient prophylactic measures for the large bodies of troops then proceeding to Egypt, I sought and obtained the occasion for the investigations in Egypt related in this report. A study of the accounts given by Sonsino and Looss of the cercariæ found by them in the course of their search showed that they had not seen and passed over the *B. cercariæ*. The bulk of their cercariæ possessed a distinct pharynx. In a few it was absent but in these there was merely an oral sucker without any development of œsophagus or gut. It was evident that these forms had still to undergo maturation before they could become infective to their definitive hosts and as some possessed a definite perforating spine and other peculiarities of forms that undergo encystment in fishes and other secondary hosts, these cercariæ were readily excluded. It was therefore necessary to find further cercariæ which had hitherto been overlooked. The search for this was made by the method of intensive study of a small heavily infected area. The fact that *B. japonica* developed in a genus of the family hydrobiidæ was of no assistance. Indeed by those unversed in the bionomics of helminths this might have been taken, disastrously, as an additional and invaluable analogy. In point of fact the Egyptian bilharzia worms were found to infest two genera of freshwater mollusca belonging not merely to a different family but to a different order. In other words, *B. japonica* and *B. hæmatobia* (s. lat.) were found in snails as distantly related in classification as are the lice to the mosquitoes. In

¹ In Egypt we found commonly present in the species which were actually intermediaries for the various *Bilharzia cercariæ* additional developmental forms; some developing in rediæ and other, bifid-tailed, forms developing in sporocysts which bore a superficial resemblance to *B. cercariæ*. It is obvious from the illustrations given by Cawston that such forms were mistaken by him for *B. cercariæ*. Thus, prior infections may prove a serious source of fallacy to those endeavouring to advance experimentally from the miracidia unless the results are carefully checked by the morphological method.

In a report written on my return from China in October, 1914, I had to content myself with the statement that my results confirmed Miyairi's main conclusion, and that in the absence of any accessible publications a comparison of the detailed conclusions was for the present impossible. Apparently during the closing months of 1914 Miyairi and Sudzuki published in Japan, in German text, a detailed account of their findings. From this, which is well illustrated, it is now evident that divergence of view regarding these "rediæ" is due solely to a difference in interpreting the same structures.

its application to these new cercariæ the morphological clue fully vindicated its use. Within three months no less than four *B. cercariæ* were obtained by this method of exclusion. Two of these were selected, on epidemiological and other grounds, and with these two alone, experiments were made on *Cercocebus fuliginosus* and other animals. These forms proved to be the infective stages of the two bilharzia worms which cause bilharziosis in man in Egypt. No experiments were made with any other cercariæ.

Here I may well bring to an end a Report that has been kept open much longer than was intended, and of which the earlier sections were written while experiments were yet in progress. Much material remains which, when elucidated, should add further to our knowledge of these and allied Egyptian parasites. Its description, however, scarcely comes within the terms of the present inquiry which were "to investigate bilharzia disease in Egypt, and advise as to the preventive measures to be adopted in connexion with the troops." These objectives, I believe, have been fully achieved. A complete zoological study of the adult parasites, or of their development, has not been attempted. Such attention as has been given to their morphology and bionomics has been directed to those points concerning which an understanding was essential as a basis for prophylactic measures. The difficulties which beset the inception of the work in a strange country, with some elements critical and hostile, were quickly overcome. Sickness, however, almost wrecked the inquiry at its commencement. Within a month of our arrival Dr. Cockin had fallen sick, and was invalided home. Three weeks earlier I had been admitted to hospital with scarlet fever. It was not until the beginning of April that, foregoing my convalescence, I was able to start field investigations at Marg. Early in May the opening of the Gallipoli campaign, with its rush of wounded and the attendant excitement in Cairo, brought pressing local suggestions for the foreclosing of my mission. As on some other occasions, one found comfort in the aphorism of Huxley: "Surely there is a time to submit to guidance, and a time to take one's own way at all hazards."

But the pervading restlessness could not be wholly withstood. Later, in June, when it seemed advisable to transfer the work to London, my second colleague, whose assistance had been invaluable, decided to remain in Egypt for general service with the Royal Army Medical Corps. The position of the inquiry was full of anxious uncertainties, and I had still to complete many of the crucial experiments. The collections made in the field had still to be worked out, and the experimentally infected animals examined histologically. The extensive literature of Bilharziosis had to be overhauled. Finally, new experiments had to be made. These were the circumstances in which the preparation of the Report had to be undertaken, and sole responsibility assumed for the conclusions arrived at and for the views herein set forth.

To the various authorities who aided the investigations in Egypt, I have already expressed my deep indebtedness.

I have now to acknowledge the warm encouragement received from home authorities, especially from Colonel W. H. Horrocks, C.B., who found time amid heavy burdens to write emphasizing the practical objectives to be kept strictly in view; from the Medical Research Committee, who not only gave more than ample financial credit for the field expenses, and to illustrate this report, but also maintained, through Sir W. M. Fletcher, F.R.S., a gracious interest in the progress of the work.

Thanks are due to Sir David Bruce for privileges enjoyed under his command at Millbank, and to the officials of the Zoological Society of London, especially to Dr. Chalmers Mitchell and Mr. R. I. Pocock, F.R.S., for supervising the supply by dealers of properly identified *Cercocebus fuliginosus*, which were the mainstay of the experimental work.

Finally, I have to express my special indebtedness to the Committee of the London School of Tropical Medicine for most generously enabling me to continue under other auspices a series of investigations which they had initiated during 1913, and which they would probably have supported alone to a successful conclusion if more peaceful times had prevailed.

THE TREATMENT OF 102 CARRIERS OF *ENTAMÆBA HISTOLYTICA* WITH EMETINE BISMUTH IODIDE.

BY CAPTAIN W. WADDELL, M.D.GLAS.
Royal Army Medical Corps.

CAPTAIN C. BANKS, M.B., B.S.LOND., D.P.H.
Royal Army Medical Corps (Bacteriologist).

H. WATSON, M.A.CANTAB., AND W. O. REDMAN KING, B.A.CANTAB.
(Protozoologists.)

(Report to the Medical Research Committee from the Dysentery Convalescent Hospital, Barton-on-Sea, Lieutenant-Colonel J. Chaytor White, I.M.S., Commanding.)

(1) INTRODUCTION.

THE cases dealt with in this paper were discovered to be carriers of *Entamæba histolytica* in the course of the ordinary routine examinations of faeces in this Convalescent Hospital; none of them were found to be carriers of dysentery bacilli. They were all treated with emetine bismuthous iodide, and it has been thought worth while publishing the results, as this is the first time, so far as we know, that the drug has been tested on such a large scale. The treatment has had the advantage of being carried out under the supervision of one medical officer at a place where the necessary protozoological examinations could be made on the spot.

(2) PREVIOUS HISTORY OF THE CASES.

All the cases came into the hospital as convalescents after dysentery, fifty-two direct from hospital ships, the remainder from home hospitals.

With 9 exceptions all the cases were invalided from the Eastern Mediterranean area (87 cases) or Mesopotamia (6 cases). The other 9 cases were invalided from France; of these, 5 had exhibited dysenteric symptoms previously in Egypt, and 2 in Gallipoli, while another (10¹) contracted dysentery in India in the autumn of 1914, just before being sent to France with a division of Indian troops; of the remaining case from France (1787) we have no further details.

Two other cases (1082, 1684) had previously had dysentery in India, in 1908 and 1914 respectively; but as one went subsequently to Gallipoli, and the other to Salonika, it cannot be said with certainty that they became infected with *E. histolytica* in India. Two cases had formerly had dysenteric symptoms in South Africa, one (787) in 1909, the other (1881) during the Boer War; while a third (1540) had "dysentery or enteric" in the Boer War.

Three cases (899, 1197, 1483) reported having diarrhoea with blood and mucus in France for a few days in 1915, before going to Salonika or Gallipoli; but it is

¹ The numbers in brackets refer to the case numbers, for which see Tables I and II.

impossible to say whether it was of amœbic origin. Seven cases which had dysentery in Gallipoli afterwards went to Salonika, where they all relapsed.

One case (902) had no history of acute dysentery; he was invalided from Salonika to Malta with nephritis, and, while in hospital there, was found to be passing cysts of *E. histolytica*; there seems no doubt he was a "contact carrier."

There is no direct evidence that in all cases the acute phase of the disease was due to *E. histolytica*; but since the majority of the cases have a history of more or less chronic or intermittent diarrhoea (even in England), with occasional relapses of an acute character, it may be presumed that in them this organism was the cause of the trouble.

A large number had been treated with emetine hypodermically, one or two having received as many as 100 injections. One case (1987) had been operated upon for liver abscess.

(3) METHOD OF TREATMENT.

The form of the drug used was a keratin-coated tabloid (prepared by Burroughs Wellcome and Co.); each tabloid contained one grain of emetine bismuth iodide, and as a rule the daily dose, consisting of three grains, was given to each man after the mid-day meal. The time of giving the daily dose was decided by the men after trials of various hours; they were less disturbed by taking the dose at mid-day than at any other time, and objected strongly to its being given at night owing to night calls to the latrine. After having their dose at 1 p.m., all lay down and rested; during the earlier part of the day they were allowed out within the lines, and, being put into blue, they were easily kept under observation. The 102 cases were treated in various batches between September 15 and November 7, 1916, and the full course extended over twelve days, until thirty-six grains of emetine bismuth iodide had been taken. The men treated in the first batch, however, had only eight or nine doses, some of which consisted of two tablets instead of three, so that they had only from twenty-one to twenty-five grains each; and two or three others who did not tolerate the drug well, but suffered from great depression, also had less than the full amount. Each man was provided with a card on which was noted the daily dose and, opposite, the result—number of times sick and number of evacuations—which it produced. Each daily dose was administered by the medical officer's own hand. All the men were placed under the same conditions of living. The diet adopted comprised mainly milk, eggs, fish, puddings, mutton and cabbage, steamed and sieved.

(4) THE EFFECTS OF THE TREATMENT ON THE MEN.

The behaviour of each case under this drug was very much the same; they practically all were either purged, or they vomited, or both. Usually a man who vomited much did not have so much diarrhoea, and a man who had much diarrhoea did not vomit so much; and usually whichever of the symptoms predominated at first, that was the most marked symptom

throughout. Very few were violently attacked both ways. Out of the 102 cases, only 2 or 3 were not affected at all, either by vomiting or diarrhoea, and a few had one natural evacuation daily; while 5 vomited only once (see tables for details). The worst cases had on some days 10 or 12 motions in 24 hours, or vomited 5 or 6, or even more times in the day. Of real tolerance of the drug there was none; certainly a number of men as time went on were not so often sick, but that was the best that could be said. The vomiting usually began about an hour after taking the dose, the diarrhoea not often sooner than three hours. Two men had violent colic and required fomentations. It was noted that in the vomit the brick-red colour of the drug was fairly often seen, showing that the keratin coat dissolved before reaching the intestine.

Various stomach and bowel sedatives were tried to control irritation, but none were of any real use except tinct. opii, and that was only used in extreme cases. The tabloids were tried in powder, but the vomiting was sooner produced and increased in intensity; so this was discontinued. A few of the most disturbed cases were kept entirely in bed, which relieved, but did not save them from, attacks of diarrhoea and vomiting.

In three cases of old carriers (1378, 787 and 10) the effect of the treatment on the general health was very pleasing. All three, particularly a staff-serjeant of the Indian Army, were weak, thin, pale and depressed; after the course appetite came back, weight was regained, and all three reported that they felt like new men. In most cases, however, the men were, for the time being, considerably pulled down by the vomiting and diarrhoea produced by the treatment. All were heartily glad when the ordeal ended and they were set free.

The tables show the curative properties which the drug certainly possesses; but until its preparation has been improved, and its intensely irritating properties abated or removed, a just estimation of its value in chronic dysentery cannot be made.

(5) COLLECTION AND EXAMINATION OF SPECIMENS.

It is obvious that the value of the microscopical examinations depends very largely upon the accuracy with which the identity of any particular specimen can be guaranteed. We think it wise to insist upon this fact, because in practice it is not easy, as might be supposed, to eliminate doubt. There are, in our experience, some men—we believe them to be few—who seem unable to realize the importance of the tests, and will exercise the utmost ingenuity in trying to substitute for specimens of their own *fæces* those of other men. In some cases this may be done as a joke; in others, a man, who suspects himself to be a positive, will endeavour to pass off as his own a specimen from a man known by reason of his approaching discharge to be free from infection. And even if the collection of specimens is so efficiently supervised that substitution is impossible,

one man may persuade another to impersonate him with the same object in view. Elaborate precautions are therefore taken at this hospital to prevent the mixing of specimens, and any sample about which there can be the slightest doubt is always rejected. We have reason to believe that in many hospitals the necessity for taking these precautions is not fully realized, and the tests made are, to a certain extent, unreliable in consequence.

The specimens were examined with the greatest care, and no test is recorded as negative unless at least two coverslip preparations, each from a different part of the faeces, had been searched without result. As a general rule the suspensions were made in normal saline, but iodine preparations were often used in addition. All problematical specimens, which were especially frequent immediately after treatment, were examined by both of the protozoologists at the hospital.

(6) RESULTS OF THE EXAMINATIONS.

In the accompanying tables will be found the exact amount of the drug received by each man, the period of treatment, the number of doses, the amount of vomiting and diarrhoea produced, and a list of all the tests made both before and after treatment. A date upon which *E. histolytica* was found is given in italics. An asterisk after the date denotes the presence of cysts, a dagger that of free amœbæ. The presence of only a small number of cysts is marked by one asterisk, of a moderate number by two asterisks, and of a large number by three asterisks; while the number of free amœbæ present is indicated by a similar number of daggers.

The cases fall into two groups: (a) Those that may have been cured, and (b) those that definitely relapsed. It is convenient to deal first with the latter group.

(a) *The Cases that were not cured.*—There can be no doubt that in nineteen out of the 102 cases the treatment failed to cure the men of their infections of *E. histolytica*. It will be seen from the table that each of these cases had repeated positive tests after the end of treatment.

It is true that the finding of a small number of specimens of *E. histolytica* on one or two occasions after treatment does not necessarily indicate that the man had not been cured. Thus, in Case 1299, two or three free amœbæ were found on the eighth day after treatment, and although the next two examinations were negative, one or two cysts of *E. histolytica* were found on November 24, twenty-six days after treatment; but since then the case has been examined fifteen times in the ensuing nine weeks, each time with a negative result; it therefore seems justifiable to include him among the probably cured. In about half a dozen other cases a few degenerate cysts, which might possibly have been those of *E. histolytica*, were found after the end of treatment (nearly always among large numbers of *E. coli* cysts). These cases were kept under observation longer than would otherwise have been the case, but as the small cysts did not recur, the tests have been recorded as negative.

In the nineteen cases that were not cured, undoubted examples of *E. histolytica* were found, often in large numbers, on at least two occasions after treatment; and the presence of the organism has been confirmed in each case by other workers since the men left the hospital.

Fifteen of these cases were examined at least once during treatment, and fourteen of them were then found to be negative. It is well known, however, that carriers of *E. histolytica* do not always pass cysts every day, at any rate in sufficient numbers to be found in practice (*vide* the examinations before treatment in the tables); the fact that many of these men had one negative examination during treatment does not, therefore, necessarily indicate that they all cleared up temporarily owing to the action of the drug. It was, however, found impracticable to make several examinations of the men while under treatment; and indeed for all practical purposes it is the examinations after treatment that are the most important.

One semi-acute case (787) had a double course of treatment. His general health improved, but at every examination numerous active amœbæ were found in the stools, and this continued after he left Barton. He has since been operated upon for amœbic abscess of the liver.

Another semi-acute case (10) also improved considerably in general health after treatment, but continued to pass at intervals sporadic active specimens of *E. histolytica*. At Barton he had three full courses of the drug, the third course being given towards the end of November. After leaving the depot he was reported to have passed on December 18 and 19 large numbers of cysts of *E. histolytica*, and smaller numbers of them on the 20th and 21st (no cysts were ever found at Barton), which disappeared under a further course of the drug. Unfortunately the man has gone back to India before his complete cure could be established.

It is difficult to assign any reason for the failure of these nineteen cases. It is possible that in some of them the full effect of the drug was not obtained, owing to a portion of the drug being lost through vomiting or diarrhœa; on the other hand, some of the worst cases in this respect are among those apparently cured (e.g., 968, 1540, 1628, 1686). Moreover, of the first batch of men treated all had considerably less than a full course of the drug, while among them only two cases definitely relapsed.

Another possible reason for some failures may be the form of drug used. In all the cases previously reported upon [2] the drug was given as a powder enclosed in gelatine capsules. Perhaps in some cases the compressed keratin-coated tablets used at Barton may not have got thoroughly broken up and some of the effect may thus have been lost. Nevertheless, the general production of intestinal disturbances and malaise tend to show that the drug did have some effect. It is possible that had the capsules been pounded up and put in cachets a more satisfactory result would have been obtained. (It is true that powdering the tablets was tried on one occasion at Barton, but, from the accounts of some of the men, the powder formed a kind of cement

TABLE I.—CASES THAT ARE NOT KNOWN TO HAVE RELAPSED AFTER TREATMENT.

Lab. No. of case	Total num-ber of grains of E.B.I. given	Period of treatment	Num-ber of doses	During treatment			Dates of protozoological examinations, those on which <i>Entamoeba histolytica</i> was found being in <i>Italics</i>		Number of neg-ative tests after end of treat-ment	Number of days between last done and last test	
				Total number of vomits	Max. number on one day	Total number of motions (approx.)	Max. number on one day	Examinations before third day of treatment			Examinations after third day of treatment
318	21	Sept. 15-22	8	11	5	8	2	Aug. 22**	Sept. 21, 23, 30, Oct. 2, 4, 5, 10, 21	7	29
814	21	Sept. 15-22	8	11	4	17	5	Aug. 23*	Sept. 21, 23, 30, Oct. 2, 4, 5, 10	6	18
940	21	Sept. 15-22	8	9	3	24	6	Sept. 6, 7†	Sept. 21, 30, Oct. 3, 4	3	12
960	21	Sept. 15-22	8	12	5	19	4	Sept. 6***	Sept. 21, 23, 29, 30, Oct. 2	4	10
1103	21	Sept. 15-22	8	2	1	14	2	Aug. 23**	Sept. 21, 23, 30, Oct. 2, 4, 10	5	18
1201	21	Sept. 15-22	8	11	4	26	5	Aug. 26*, 28†	Sept. 21, 23, 29, Oct. 2, 4	4	12
1359	21	Sept. 15-22	8	8	4	14	4	Aug. 19*, 24	Sept. 21, 23, 30, Oct. 2, 4, 10	5	18
1003	22	Sept. 15-22	8	19	5	31	10	Sept. 8†	Sept. 21, 23, Oct. 2, 3, 4	4	12
738	24	Sept. 15-23	9	7	4	18	4	Aug. 17, 27*	Sept. 22, 23, 25, 30, Oct. 5, 6	4	13
975	24	Sept. 15-23	9	8	3	16	3	Sept. 7***	Sept. 21, 25, Oct. 2, 4, 5	4	12
1082	24	Sept. 15-23	9	11	4	20	5	Aug. 30*	Sept. 22, 25, 30, Oct. 2, 4, 10	5	17
1138	24	Sept. 15-23	9	6	2	13	2	Aug. 21***	Sept. 22, 25, 29, Oct. 3, 4, 11	5	18
1181	24	Sept. 15-23	9	6	3	33	8	Aug. 21**	Sept. 22, 25, 29, Oct. 2, 4	4	11
1436	24	Sept. 15-23	9	3	3	36	10	Aug. 23†	Sept. 22, 25, 29, Oct. 3, 4, 5, 11, 12, Nov. 2	8	40
1532	24	Sept. 15-23	9	11	3	13	3	Sept. 6***	Sept. 22, 25, 30, Oct. 2, 4, 5	5	12
1574	24	Sept. 15-23	9	7	4	16	2	Aug. 28*	Sept. 22, 25, 30, Oct. 2, 4, 5, 10	6	17
879	25	Sept. 15-23	9	1	1	9	1	Sept. 13***	Sept. 22, 25, 29, Oct. 3, 4, 11	5	18
1540	27	Sept. 29-Oct. 10	12	35	12	23	5	Aug. 26*, Sept. 8†, 30	Oct. 7, 13, 17, 21, 28	4	18
968	30	Oct. 12-24	11	18	5	51	10	Sept. 27*, 28*, Oct. 11*	Oct. 25, 30, Nov. 1	3	8
935	33	Oct. 12-23	12	16	4	39	6	Sept. 7†, 27*, Oct. 13	Oct. 25, 30, Nov. 2	3	10
1475	33	Sept. 28-Oct. 9	12	18	4	44	7	Aug. 24*, Sept. 27**	Oct. 5, 13, 17, 19, 26	4	17
1788	34	Sept. 29-Oct. 10	12	3	2	23	3	Sept. 16*	Oct. 8, 16, 18, 20, 23, 29, Nov. 2	6	23
1197	35	Sept. 28-Oct. 9	12	28	4	34	12	Sept. 4, 8**, 27*	Oct. 6, 16, 17, 21, 30	4	21
1380	35	Sept. 29-Oct. 10	12	17	2	38	5	Aug. 21*, Sept. 28	Oct. 7, 13, 17, 19, 26	4	16
845	36	Sept. 28-Oct. 9	12	..	..	16	2	Sept. 11**, 28*	Oct. 6, 13, 17, 19, 26	4	17
849	36	Sept. 20-Oct. 10	12	13	3	28	2	Sept. 11**, 30	Oct. 6, 13, 17, 19, 26	4	16
855	36	Oct. 12-23	12	5	3	43	6	Sept. 4, 8, 11*, 16, 22*, Oct. 11	Oct. 25, 30, Nov. 1, 6, 8, 23	6	31
965	36	Oct. 12-23	12	13	3	27	3	Sept. 14*, 23*, Oct. 11*	Oct. 25, 30, Nov. 1, 6	4	14

978	36	Oct. 12-23	12	3	1	23	4	Sept. 14, 27, ... Oct. 11*	...	Oct. 26, 30, Nov. 1, 2	...	4	10
1299	36	Sept. 28-Oct. 9	12	8	2	18	2	Sept. 8, 27	...	Oct. 6, 13, 17, 19, 26	...	3	17
1328	36	Oct. 12-23	12	8	2	42	6	Aug. 18, ... Sept. 27, ... Oct. 11*	...	Oct. 25, 30, Nov. 2, 6, 24	...	5	32
1329	36	Sept. 28-Oct. 9	12	...	...	17	4	Aug. 18, Sept. 27	...	Oct. 7, 13, 17, 19, 30	...	4	21
1330	36	Sept. 28-Oct. 9	12	...	...	15	4	Aug. 18, Sept. 8, ... 27*	...	Oct. 6, 14, 17, 19, 30	...	4	21
1356	36	Oct. 12-23	12	2	1	34	6	Aug. 19, Sept. 16*	...	Oct. 25, 30, Nov. 2	...	3	10
1372	36	Oct. 12-23	12	2	1	15	2	Aug. 21, Sept. 15, ... Oct. 11	...	Oct. 25, 30, Nov. 1	...	3	9
1378	36	Sept. 30-Oct. 11	12	6	3	17	3	Aug. 21, Sept. 27	...	Oct. 8, 14, 17, 19, 26	...	4	15
1402	36	Oct. 12-23	12	8	2	31	4	Aug. 22, Sept. 13, ... 27, Oct. 11	...	Oct. 25, 30, Nov. 1	...	3	9
1450	36	Sept. 28-Oct. 9	12	13	2	16	2	Aug. 23, Sept. 11, ... 27, ...	...	Oct. 5, 16, 17, 19, 28	...	4	19
1454	36	Sept. 28-Oct. 9	12	...	...	23	4	Aug. 23, ... Sept. 27, 30	...	Oct. 7, 13, 17, 19, 26	...	4	17
1472	36	Sept. 28-Oct. 9	12	7	...	29	5	Aug. 24, ... Sept. 27, ...	...	Oct. 7, 13, 17, 19, 26	...	4	17
1483	36	Sept. 28-Oct. 9	12	14	2	19	3	Aug. 24, Sept. 9, ... 22, 28*	...	Oct. 5, 14, 17, 19, 28	...	4	19
1490	36	Sept. 28-Oct. 9	12	...	...	18	3	Aug. 24, Sept. 27	...	Oct. 6, 13, 17, 19, 26	...	4	17
1514	36	Sept. 28-Oct. 9	12	3	2	21	3	Aug. 25, Sept. 7, ... 27*	...	Oct. 6, 14, 17, 19, 28	...	4	19
1517	36	Sept. 28-Oct. 9	12	7	2	19	4	Aug. 25, Sept. 7, ... Sept. 28*	...	Oct. 6, 14, 17, 19, 21, 25, 28, 31, Nov. 2, 6	...	9	28
1522	36	Sept. 28-Oct. 9	12	1	1	24	4	Aug. 25, Sept. 7, 28	...	Oct. 8, 14, 18, 20, 28	...	4	19
1525	36	Sept. 28-Oct. 9	12	5	2	22	2	Aug. 25, Sept. 7, ... 28*	...	Oct. 6, 9, 14, 18, 20, 28	...	4	19
1527	36	Sept. 28-Oct. 9	12	12	2	27	3	Aug. 25, ... Sept. 11, ... 30*	...	Oct. 5, 14, 20, 21	...	3	12
1539	36	Sept. 28-Oct. 9	12	1	1	35	4	Aug. 26, ... Sept. 8, ... 28	...	Oct. 5, 14, 18, 20, 28	...	4	19
1583	36	Sept. 28-Oct. 9	12	12	3	27	4	Aug. 28, Sept. 7, ... 28, ...	...	Oct. 6, 12, 16, 20, 27	...	4	18
1585	36	Sept. 28-Oct. 9	12	1	1	41	6	Aug. 29, Sept. 28*	...	Oct. 7, 13, 18, 21	...	3	12
1622	36	Oct. 12-23	12	...	...	12	1	Aug. 30, Sept. 18, ... Oct. 10*	...	Oct. 21, 27, 31, Nov. 2, 9, 13	...	6	21
1628	36	Oct. 12-23	12	25	6	28	3	Aug. 30, Sept. 25, Oct. 4, ... 5, ... 6, 9, 10, 11*	...	Oct. 24, 31, Nov. 2, 7, 10	...	5	18
1650	36	Sept. 29-Oct. 10	12	15	3	25	4	Aug. 31, ... Sept. 30*	...	Oct. 7, 12, 16, 18, 24, 27	...	5	17
1653	36	Sept. 28-Oct. 9	12	2	1	37	5	Aug. 31, ... Sept. 30	...	Oct. 7, 12, 16, 18, 27	...	4	18
1656	36	Oct. 12-23	12	2	3	21	2	Aug. 31, Sept. 19, ... 25, Oct. 13*	...	Oct. 21, 26, 27, Nov. 2	...	4	10
1658	36	Sept. 28-Oct. 9	12	2	1	32	5	Aug. 31, Sept. 30*	...	Oct. 5, 12, 16, 18, 24, 28	...	5	19
1661	36	Sept. 28-Oct. 9	12	12	3	32	4	Aug. 31, Sept. 30*	...	Oct. 7, 12, 16, 18, 24, 27	...	5	18
1686	36	Sept. 28-Oct. 9	12	29	5	31	5	Sept. 11	...	Oct. 8, 12, 16, 21, 27	...	4	18

TABLE I.—CASES THAT ARE NOT KNOWN TO HAVE RELAPSED—Continued.

Lab. No. of case	Total number of grains of E. B. I. given	Period of treatment	Num-ber of doses	During treatment				Dates of protozoological examinations, those on which <i>Entamoeba histolytica</i> was found being in <i>italics</i>		Number of neg. tests after end of treat-ment	Number of days between last dose and last test
				Total number of vomits	Max. number on one day	Total number of motions (approx.)	Max. number on one day	Examinations before third day of treatment	Examinations after third day of treatment		
1712	36	Sept. 28—Oct. 9..	12	12	2	40	6	Sept. 4,* 30 ..	..	Oct. 5, 12, 16, 18..	9
1718	36	Sept. 28—Oct. 9..	12	20	3	47	7	Sept. 4,* 19,* 30*	..	Oct. 6, 12, 16, 18, 27	18
1727	36	Sept. 28—Oct. 9..	12	2	2	33	5	Sept. 4,* 19, 26,* 28*	..	Oct. 5, 12, 16, 18..	9
1734	36	Oct. 12—23 ..	12	10	2	15	2	Sept. 4, 19, Oct. 2,* 10*	..	Oct. 24, 27, 31, Nov. 2	10
1735	36	Sept. 28—Oct. 9..	12	22	3	35	5	Sept. 4,* 25,* 28*	..	Oct. 6, 12, 16, 19, 27	18
1754	36	Sept. 29—Oct. 10	12	8	1	15	2	Sept. 8, 15,* 30 ..	..	Oct. 16, 18, 19, 26	16
1755	36	Sept. 28—Oct. 9..	12	12	3	11	1	Sept. 5,* 30**	..	Oct. 7, 12, 16, 18..	9
1783	36	Oct. 12—23 ..	12	9	3	19	3	Sept. 15,* 30** Oct. 11*	..	Oct. 25, 30, Nov. 1	9
1787	36	Oct. 12—23 ..	12	20	4	35	5	Sept. 15,* Oct. 11 ..	..	Oct. 26, Nov. 2, 4	12
1793	36	Oct. 12—23 ..	12	4	3	23	3	Sept. 18,* Oct. 10*	..	Oct. 27, 31, Nov. 2	10
1834	36	Oct. 12—23 ..	12	6	3	35	3	Sept. 29,* Oct. 5,* 9, 11*	..	Nov. 10, 13, 14 ..	22
1867	36	Oct. 12—23 ..	12	19	5	27	6	Oct. 2,* 10** ..	..	Oct. 24, 27, 31, Nov. 2	10
1868	36	Oct. 12—23 ..	12	5	2	16	3	Oct. 2,* 16*	..	Oct. 24, 27, 31, Nov. 2	10
1904	36	Oct. 12—23 ..	12	1	1	21	3	Oct. 4,* 10 ..	..	Oct. 24, 27, 31, Nov. 2	10
1911	36	Oct. 12—23 ..	12	3	1	39	4	Oct. 5,* 11*	..	Oct. 25, 30, Nov. 1	9
1941	36	Oct. 12—23 ..	12	7	2	25	3	Oct. 6,* 11*	..	Oct. 27, 31, Nov. 2	10
1963	36	Oct. 27—Nov. 7..	12	12	2	26	5	Oct. 10,* 16†*	..	Nov. 13, 15, 20, Dec. 4, 6	29
1974	36	Oct. 27—Nov. 7..	12	5	2	29	4	Oct. 10**	..	Nov. 13, 15, 20, 29, Dec. 12	35
1982	36	Oct. 27—Nov. 7..	12	9	3	28	3	Oct. 10,* 26**	..	Nov. 16, 18, 20, 28, Dec. 7	30
1987	36	Oct. 27—Nov. 7..	12	11	2	27	3	Oct. 12,* 16,* 18	..	Nov. 13, 15, 20, Dec. 1, 6	29
2031	36	Oct. 27—Nov. 7..	12	6	2	89	5	Oct. 14,†*	..	Nov. 13, 15, 20, 29	23
2063	36	Oct. 27—Nov. 7..	12	4	1	37	4	Oct. 16*	..	Nov. 13, 16, 20 ..	13
2084	36	Oct. 27—Nov. 7..	12	18	3	20	3	Oct. 17,† 29	..	Nov. 15, 18, 22, 24, 28, Dec. 5, 7..	30
2191	36	Oct. 27—Nov. 7..	12	2	1	33	4	Oct. 20**	..	Nov. 13, 14, 15, 21, 28, Dec. 7..	30
2195	36	Oct. 27—Nov. 7..	12	13	3	17	2	Oct. 20** ..	..	Nov. 13, 18, 20, 28, Dec. 7 ..	30

TABLE II.—CASES THAT WERE NOT CURED BY THE TREATMENT.

Lab. No. of case	Total number of grains of E. I. given	Period of treatment	Number of doses	During treatment			Dates of protozoological examinations, those on which <i>Entamoeba histolytica</i> was found being in <i>italics</i>		Number of neg. tests between treatment and first pos. test	Number of days between treatment and first pos. test
				Total number of vomits	Max. number on one day	Total number of motions (approx.)	Max. number on one day	Examinations before third day of treatment		
899	21	Sept. 15–23	8	11	4	19	6	Sept. 12*	3	13
1393	24	Sept. 15–23	9	11	5	16	4	Aug. 21***	1	7
902	36	Sept. 28–Oct. 9	12	4	1	19	2	Sept. 12*, 27*	2	10
1324	36	Oct. 12–23	12	19	4	24	4	Aug. 18, Sept. 8*, 28*, Oct. 11**	1	7
1428	36	Oct. 12–23	12	23	3	27	4	Aug. 22, Sept. 14***, Oct. 11	0	2
1444	36	Sept. 28–Oct. 9	12	14	3	35	4	Aug. 23*, Sept. 27**	0	4
1553	36	Sept. 28–Oct. 9	12	11	2	31	4	Aug. 26, Sept. 7**, 28*	0	8
1614	36	Oct. 12–23	12	9	2	11	2	Oct. 10*	1	10
1684	36	Oct. 12–23	12	7	2	46	5	Sept. 1, 1†, Oct. 5, 11†	1	7
1688	36	Sept. 28–Oct. 9	12	8	3	25	3	Sept. 2*, 29**	0	5
1690	36	Sept. 28–Oct. 9	12	2	2	21	2	Sept. 2*, 28**	0	5
1763	36	Oct. 12–23	12	8	2	11	1	Sept. 14†, Oct. 1*	1	7
1765	36	Oct. 12–23	12	15	3	26	3	Sept. 14***, 23*, Oct. 11	2	9
1847	36	Oct. 12–23	12	21	3	12	2	Sept. 29*, Oct. 11	2	9
1851	36	Oct. 12–23	12	8	4	15	2	Oct. 3***, 10	0	1
2089	36	Oct. 27–Nov. 7	12	7	1	37	4	Oct. 17***	0	6
2122	36	Oct. 27–Nov. 7	12	12	3	23	4	Oct. 18*	0	7
757	63	Sept. 15–Oct. 9	22	5	1	60	5	Sept. 12††	0	7
10	72	Sept. 20–Oct. 23	24	18	2	53	8	Sept. 28††, 29††, 30††, Oct. 1*	0	1
								Oct. 2, 3, 4, 5, 6, 7, 8, 9††, 10††, 12, 13, 14, 16, 17, 18, 19, 20†, 21, 22, 24†, 25, 26, 27, Nov. 8, 11†, 12, 14†, 15†, 17		

on the tongue and was difficult to swallow : a cachet or capsule would overcome this difficulty.) On the other hand, one case (C. 26) at Chichester [3] was not cured by a course of forty grains of the powdered drug, though he may have been cured by a subsequent course of sixty-eight grains.

The duration of infection or the region where it was acquired may possibly have some effect, for it is noteworthy that four out of the five men who are known to have had dysentery previously in South Africa or India (viz., 10787, 1684, 1881) were among those who relapsed. There is no evidence however that the failure is in any way connected with the intensity or duration of the acute symptoms : indeed, among the relapses is included the one case that had never had any symptoms of acute dysentery (902).

Dobell has shown that emetine hydrochloride fails to cure about two-thirds of the cases treated. It seems to us that while emetine bismuth iodide is a much more efficient drug, nevertheless, at any rate in the form used at Barton, it may fail to extirpate about twenty to twenty-five per cent of *E. histolytica* infections. Again, a man who has once relapsed after emetine hydrochloride injections is very seldom cured by a further course of the drug [4], and similarly the two cases (10 and 787) which had more than one course of emetine bismuth iodide at Barton were still not cured. All the cases that relapsed at Barton have again relapsed after another full course of the drug, with the exception of three men (899, 1393, and 1765). Of these 1393 has been under observation since treatment for eight weeks, during which he has had nine examinations, all negative, while 1765 has had, similarly, six negative examinations in five weeks, and it seems likely, therefore, that both these cases have been cured.¹ The other case has only had four negative examinations (three within eight days of the end of treatment) and his "cure" is therefore much more open to doubt. It seems possible, however, that there may be some cases which are permanently resistant to emetine bismuth iodide.

(b) *Cases that were apparently cured.*—While there can be no doubt about the cases that relapsed, it is by no means so certain that the remainder were permanently cured ; for it is conceivable that some relapsed after they were last examined. The evidence of cure depends upon the value of the negative examinations, and until we know more about the way in which the presence of *E. histolytica* in the fæces of relapsing carriers may vary from day to day, it is impossible to speak with certainty.

We can, however, draw certain conclusions from the behaviour of the

¹ Since this paper was written both these cases have relapsed. 1393 had twelve negative examinations after treatment at Mont Dore Hospital between the end of November and the middle of February, 1917 ; he had another negative test at Barton on February 17. He was subsequently reported to be passing blood in his stools and a further examination on March 6 revealed the presence of large numbers of cysts of *E. histolytica*. In view of the long period during which this case was negative it is probable that the opinion expressed at the end of paragraph 6 (b) above, concerning late relapses, will have to be somewhat modified.

cases that did relapse. The table shows that cysts generally reappeared in the faeces fairly soon after treatment had ceased: thus, out of the 19 cases, 10 were discovered still to be infected on the first, 5 on the second, 3 on the third, and 1 on the fourth examination after treatment. The average number of days between the last dose and the first positive test was only 6.5; and it is probable that, had daily examinations been made, it would have been much smaller. The longest period between the last dose and the last negative test was never more than 8 days, except in 1 case where it was 4 days longer.

The remaining cases, on the other hand, had an average of 4.3 negative tests after the end of treatment, the average number of days between the last dose and the last test being 17.3. Only 1 case did not have at least 1 examination later than the eighth day after the end of treatment, and many had 3 or 4; indeed, if we take the 65 cases that had 12 doses, we find that they had altogether 144 negative tests later than the eighth day after the end of treatment, an average of over 2 per man.

It is improbable, therefore, that, had many cases relapsed later, some would not have been detected: and the foregoing facts, together with what we know of other cases followed over longer periods [5], warrant us in the belief that the majority of these eighty-three cases may really have been permanently cured.

(7) ON THE AMOUNT OF EMETINE BISMUTH IODIDE NECESSARY TO AFFECT A CURE.

Nineteen cases had only 8 or 9 doses, amounting to 21-25 grains of the drug, and other 7 had also less than 36 grains: yet of these 26 cases only 2 (899 and 1393) definitely relapsed. Most of the others had at least two negative tests subsequent to the eighth day after treatment, and in only nine cases was the last test previous to the thirteenth day after treatment. On the other hand, the two cases that relapsed are among the three that seemed to have cleared up permanently after the second course of treatment (*vide supra* 6 (a), last paragraph), and it seems possible that on the first occasion they did not get sufficient of the drug.

It appears, therefore, that while there are undoubtedly cases which clear up under a smaller amount of the drug [6], it is preferable to give the full course of thirty-six grains as a general rule. But if the ill effects of the treatment on a man's general health are very marked, it would seem quite justifiable to give a somewhat shorter course, inasmuch as it seems likely that the first eight or nine doses of the drug may cure the great majority of those cases which it can cure at all.

(8) LENGTH OF TIME DURING WHICH IT IS ADVISABLE TO KEEP PATIENTS UNDER OBSERVATION AFTER TREATMENT.

If all cases could be cured by the drug, as early work seemed to indicate, no examinations after treatment would of course be necessary. Our observations, however, seem to show that we may expect twenty to twenty-five

per cent of failures; and although this is a much better result than that obtained with emetine hydrochloride, yet it indicates that the success of the treatment should be checked by adequate protozoological supervision, if the end aimed at is the elimination of the convalescent carrier, in which case it is important that relapses should be detected.

The results detailed above seem to show that in the majority of cases that are going to relapse cysts will be found in the faeces within a very few days of the end of the treatment, and somewhat earlier, apparently, on an average than in cases that relapse after treatment with emetine hydrochloride. One case, however, was not detected until the thirteenth day after completing his course, and if examinations are only made at intervals of a few days, some such cases are bound to escape earlier detection.

Again, it is evident that negative examinations made during or immediately after treatment are of very little value. Leaving out No. 10, which case was examined daily, nine out of the remaining eighteen cases were negative upon their first examination after treatment. In all they were examined 77 times after treatment, and 30 of these examinations (nearly 40 per cent) were negative, while 6 cases had 2 or more negative examinations.

From these considerations, therefore, it would appear advisable that cases which have been treated with emetine bismuth iodide should be kept under observation for not less than a fortnight after the completion of treatment, during which time as many tests as possible (certainly not less than four) should be made.

(9) EFFECTS OF TREATMENT ON OTHER PROTOZOA.

Fifty-six of the carriers treated were found to be infected with *E. coli*, in 13 of whom it was found once only. In 11 cases it was found only before, and in 11 others only after, treatment. It appears to be at least temporarily affected by the drug, disappearing during treatment, but generally reappearing sooner or later. There is, moreover, a remarkable similarity in the usual time of its reappearance to that of *E. histolytica* in the cases that relapsed. Thus, omitting the 11 cases in which it had not been found before treatment, it reappeared in 19 cases on the first, 12 on the second, and 3 on the third examination after treatment. The average number of days between the last dose and its reappearance was 6.05 (compared with 6.5 for *E. histolytica*), and the longest period between the last dose and the last negative test before its reappearance was 8 days, as in the case of *E. histolytica*, except in 1 case where it was 11. Thus in general its behaviour is strikingly similar to that of *E. histolytica* in those cases that relapsed.

On the other hand, the flagellate parasites of the small intestine appeared to be unaffected by the drug. *Giardia* (*Lamblia*) was found in 29 of the 102 cases, usually in the encysted form; it was present in the faeces on ten occasions during treatment.

Chilomastix occurred in 12 cases; the unencysted form was less uncommon than that of *Giardia*, being present on 7 occasions, 4 of them during treatment.

Trichomonas was found in two cases only, on the same date during treatment.

CONCLUSIONS.

(1) Emetine bismuthous iodide is much more effective than emetine hydrochloride in the treatment of carriers of *E. histolytica*, but about twenty to twenty-five per cent of failures may occur.

(2) The intensely irritating properties of the drug in many cases are a drawback in its general application.¹

(3) The definite failure to cure nineteen out of the 102 cases treated at Barton may perhaps be in part due to the form of drug employed (a keratin-coated tabloid).

(4) It is improbable that there were many relapses later than those discovered; and as several of the cases had only 8 or 9 doses instead of 12, it seems likely that less than 36 grains may be effective.

(5) It is advisable to keep cases under observation for not less than fourteen days after treatment, and to examine them not less than four times during that period, if relapses are to be detected.

(6) The drug is without appreciable effect upon the intestinal flagellates, but has an effect, usually temporary, on *E. coli*.

ACKNOWLEDGMENTS.

For information relating to cases which were afterwards treated and studied at Mont Dore Military Hospital, Bournemouth, we are indebted to Captain Shepherd, R.A.M.C., and Mr. D. G. Lillie; for information regarding Case 10 to Dr. G. C. Lord. Captain Cambell, R.A.M.C., of Hilsea Military Hospital, kindly enabled us to continue our observations on Case 1974.

REFERENCES.

- [1] Cf. also DOBELL: "Amœbic Dysentery and the Protozoological Investigation of Cases and Carriers," *Medical Research Committee, Special Report Series*, No. 4, 1, January, 1917.
- [2] See DALE: "Treatment of Carriers of Amœbic Dysentery, &c.," *Lancet*, July 29, 1916. LOW and DOBELL: "Three Cases of *Entamoeba histolytica* Infection treated with Emetine Bismuth Iodide," *Lancet*, August 19, 1916. DOBELL: "Incidence and Treatment of *Entamoeba histolytica* Infection at Walton," *British Medical Journal*, November 4, 1916.
- [3] DOBELL: January, 1917, *loc. cit.*, pp. 80 and 81.
- [4] *Ibid.*, p. 76.
- [5] See DOBELL: November, 1916, *loc. cit.*, remarks on fourth series, and January, 1917, *loc. cit.*, p. 81.
- [6] Cf. LOW and DOBELL: *Loc. cit.*, Case 3.

¹ Since the above was written a new preparation of the drug in the form of salol-coated pills has been introduced by Dr. H. H. Dale; we are informed that this preparation of the drug is much less irritating than that used at Barton.

FUSO-SPIROCHÆTAL AFFECTIONS OF THE MOUTH AND PHARYNX.

BY CAPTAIN W. H. MCKINSTRY.

Royal Army Medical Corps.

Bacteriologist and Pathologist, Queen Alexandra Military Hospital.

PRIOR to the end of the last century most of these affections, from their clinical appearance, were doubtless classed with diphtheria and croup. Since Klebs in 1882 investigated the specific cause of diphtheria, these fuso-spirochætal affections, owing to the advances in bacteriology, have gradually become differentiated and now form well defined clinical entities. Although their early history is so recent, it is not quite clear to whom the honour belongs of first describing the organisms with which they are associated.

By some it is ascribed to Babes [1] (1884), while others award the distinction to Miller [2], an American practising dentistry in Germany, who mentioned organisms, similar if not identical to those found, as early as 1882. Plaut [3] certainly described and pictured the organisms in 1894 and his name is often coupled and applied with that of Vincent to the associated bacillus as the Plaut-Vincent organism. Vincent [4] in 1896 described the spindle-shaped bacillus in hospital gangrene and gave it the name fusiform bacillus.

In 1898 and 1899 Vincent further elaborated and published his researches on the organisms and their associated affections of the mouth and tonsils, and the affection of the latter has since been known as "Vincent's angina," and the organisms found are frequently spoken of as Vincent's organisms or *Bacillus vincenti* and *Spirochæta vincenti*.

Vincent's publications appear to have attracted considerable attention and possibly stimulated research, for since their appearance many diseases have been recorded associated with the fuso-spirochætal organisms and many papers dealing with the bacteriological properties of the organisms have appeared in the medical literature of Europe and America.

In England fuso-spirochætal affections of the mouth and tonsils appear to have scarcely received the attention they deserve, for few contributions on them are to be found in our journals and in some of our recently published text-books they have not yet secured a place, while in others they are dismissed as if clinical rarities. In fact, as far as my inquiries go, the English literature of these affections is almost exclusively devoted to Vincent's angina, while the affections of the gums, the *fons et origo* of Vincent's angina and allied ulcerations of the palate, cheek, etc., have scarcely been mentioned.

That the affections are very prevalent among soldiers the number of cases met with at Queen Alexandra Military Hospital proves, and there are reasons to doubt that the civil population is as free from the affections

as our literature on the subject leads us to believe. Out of two hundred and thirty healthy recruits—men who had not yet left their homes for military service—I found fusiform bacilli and spirochætæ in the mouths of ninety-five.

GEOGRAPHICAL DISTRIBUTION.

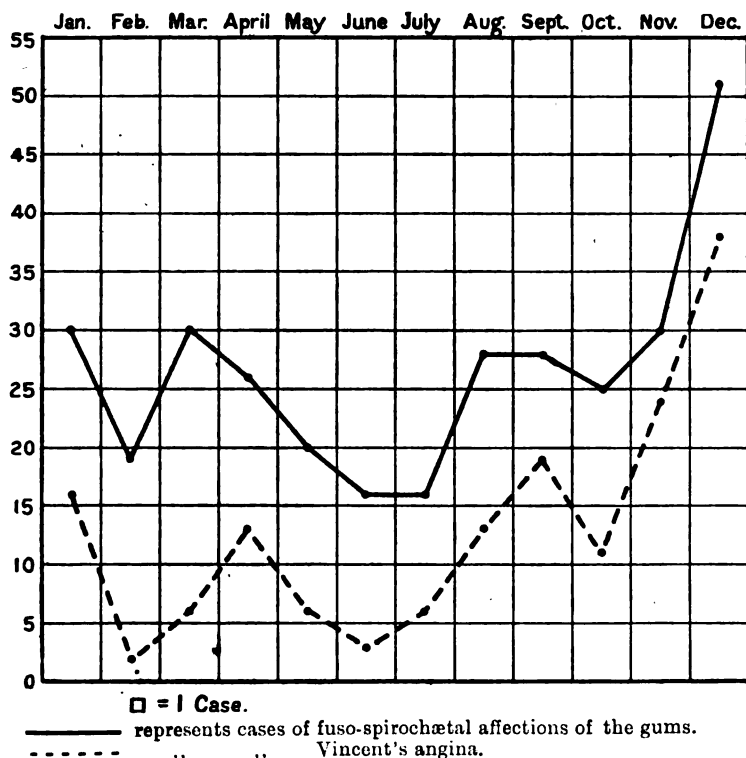
Fuso-spirochætal affections of the mouth and tonsils appear to be distributed over a wide area of the globe both North and South of the Equator. They have been recognized in all European countries, Canada, United States, Australia, New Zealand, and I am informed by officers of the Indian Medical Service that ulceration of the gums due to these organisms is prevalent in India, particularly among the European section of the community.

TABLE OF CASES OF VINCENT'S ANGINA.

January ..	16	July ..	6
February ..	2	August ..	13
March ..	6	September ..	19
April ..	13	October ..	11
May ..	5	November ..	24
June ..	3	December ..	38

TABLE OF CASES OF FUSO-SPIROCHÆTAL ULCERATION OF THE GUMS.

January ..	30	July ..	16
February ..	19	August ..	28
March ..	30	September ..	28
April ..	26	October ..	25
May ..	20	November ..	30
June ..	16	December ..	51



SEASONAL VARIATION.

Acute tonsillar affections in this country usually show a seasonal variation, occurring most frequently in spring and autumn. Dr. J. D. Rolleston [5] published a paper on thirty-two cases of Vincent's angina observed in children, and therein stated he found Vincent's angina commonest in spring and rarest in autumn.

Above are monthly tables of the numbers of cases of Vincent's angina and fuso-spirochætal ulcerations of the gums met with at Queen Alexandra Military Hospital during the year 1916.

From the above tables it will be observed the diseases are commonest during the winter months, and the numbers of cases of Vincent's angina rise and fall with the cases of fuso-spirochætal ulceration of the gums. These facts are well brought out in the accompanying graph. But it is to be remembered that the conditions of life have so materially changed in the present state of stress, it is obviously unsafe to draw any general conclusion of seasonal variation from the above tables.

OCCUPATION AND AGE.

Nearly all my cases occurred in soldiers; the only exceptions were three nurses and three wives of officers. The ages of those affected varied between 16 and 60.

PREDISPOSING CAUSES.

Vincent laid special stress on general ill-health and oral sepsis. Cold, damp and insanitary surroundings have also been mentioned as contributing causes. Bruce [6], Halsted [7] and others have reported cases in diseased and debilitated subjects running on to fatal endings.

Nearly all my cases occurred in young, robust, healthy-looking men. Overcrowding and its concomitants may be a predisposing cause, as many cases came from barracks possibly overcrowded as a result of the War. On the other hand, a large proportion of cases were officers living in billets or at their own homes. There can be no doubt that oral sepsis plays a very important part; about thirty per cent of the cases seen by me showed decayed teeth, and a larger proportion want of oral cleanliness. In a large number of the latter the mouth toilet had been discarded on account of the pain and the bleeding excited.

Drs. Harwood-Yarred and Panton [8] found carious teeth in seven cases out of ten children examined by them.

Rolleston [5] found carious teeth in his cases (all children), but not to a greater extent than in other children.

Many of my cases occurred in officers and men who scrupulously attended to their teeth, in fact, the frequency with which the gums were affected where the teeth had been well looked after was surprising. Irregular teeth, badly filled, capped and bridged teeth were most frequently attacked, but one never met the badly neglected mouth so frequently seen in the out-patient department of a general hospital.

A few cases (twelve) occurred after having teeth extracted or scaled by dentists; the gums of these patients may have been injured and thus allowed the organisms to gain a foothold and excite ulceration.

INFECTIVITY.

The affections do not appear to be highly infectious.

Many cases of severely affected gums and Vincent's angina were treated in the general medical wards without any of the nursing staff or any of the other patients becoming affected.

Cases of direct infection have been reported by Peters [9], such as the hand becoming infected after striking a person in the mouth.

Hultgens [10] reports the case of a girl who infected her left index finger through biting her nails.

Small epidemics in children's homes have also been reported. Several of my cases prove the disease can be conveyed from one person to another. The following is a good example:—

Mrs. P., wife of Captain P., R.N., was referred to me for treatment for pyorrhœa. She said her gums had bled for three months. She consulted a dentist, who told her she had pyorrhœa and advised her to have her teeth extracted. To this her father, who was a Colonel in the I.M.S., objected. Her teeth were in perfect condition, but small ulcers could be seen at the tops of the papillæ between the teeth of the lower jaw and between the incisors of the upper jaw. The gums about these parts were separated from the teeth and bled when touched with a platinum loop. There were no pus pockets, no looseness of the teeth nor noticeable fœtor of breath. Smears from the gums examined microscopically showed many fuso-spirochætal organisms. Her father, who was present during the examination, suggested she might have caught the disease from a toy terrier she was in the habit of kissing and fondling; smears from the dog's gums, however, proved negative. While treating Mrs. P. she asked if I would examine her husband's gums as he was suffering from the same affection. He attended the next day, and I found his gums about the lower incisors ulcerated, tender, and bled from the slightest touch. Smears from his gums examined microscopically showed many fusiform bacilli and spirochætæ. He said he had been on leave from his ship for a month and his gums had bled for three weeks; he was quite sure he had caught the disease from his wife as he had never been troubled before with his gums.

Case 2.—Serjt. B., invalided from France—wounded in the thigh—was sent to me on account of a sore throat which had troubled him for a week. I found his left tonsil ulcerated, his breath fœtid, and his gums ulcerated and easily excited to bleed. He never complained of his gums, but when questioned about them, he said, "they had bled for about six months and now his wife was troubled in the same way." Smears from his gums showed many fusiform bacilli and spirochætæ.

As already stated, many cases came from barracks and billets where

they lived in close contact and liable to infect one another in several ways. Pte. S., Australian Post Services, living in billets with sixteen other men, three of whom were already under treatment for fuso-spirochætal ulceration of the gums, said he thought he caught his complaint a month ago through using by mistake a toothbrush of one of the men under treatment. I found a deep ulcer on his right tonsil which had pained him for three days, and his gums had been bleeding for three weeks. His disease was verified by the microscope. I also examined the tooth-brushes of the four affected men and found fusiform bacilli in all.

There can be no doubt that the disease can also be conveyed by the mouth-pieces of pipes, cigarette holders, gas masks, and other articles coming in contact with the mouth, and I have found fusiform bacilli in smears taken from the inside of mouth-pieces of pipes and cigarette holders. These modes of infection, however, account for only a few of the cases seen. Many of the cases came from their homes or billets removed from overcrowding and insanitary conditions, from whom no evidence of infection could be obtained.

The origin of the affections in these cases seems to find the best explanation in the frequency with which the exciting organisms are found leading a saprophytic life in what appear to be healthy mouths.

I examined microscopically smears from the throats of 1,320 healthy soldiers and found fuso-spirochætal organisms in thirty-two. I also examined smears from the gums of 230 healthy men who had not yet started military life and found no less than ninety-five positive. It thus looks as if these saprophytic organisms can under certain conditions become pathogenic [21].

The proportion of "healthy carriers" is highly significant. What the conditions in the life of the soldier are which stimulate these organisms into pathogenic activity I can offer no explanation. Neither can I see any explanation for the presumed greater prevalence of the affections among soldiers than among the civil population. The disease certainly is not allied to scurvy, nor can it be attributed to any want of fresh vegetables or fruit or dietetic errors. Tobacco smoking, mentioned by some as a contributing cause, does not offer any solution, as several cases occurred in non-smokers—*rare aves* in the Army.

EXCITING CAUSE.

"The affection is caused by an apparent association of a bacillus and spirochæte" [11]. The bacillus, first called by Vincent the fusiform bacillus, is straight or slightly curved and tapering at both ends. It is about four to twelve microns in length and about one micron in thickness.

Vincent, Weaver and Tunnicliff [12] state it to be non-motile, while others, including Abel [13] and Bernheim [14], assert it to be motile. My observations made in hanging drops of warm normal saline.

lead me to the conclusion that it is non-motile. The small amount of motility I have occasionally observed appeared to be due to small currents in the fluid.

According to Beitzke [15] flagella have been demonstrated by Graupner, and this observation has been confirmed by Muhlens.

The *Bacillus fusiformis* is easily stained by the basic aniline dyes, particularly weak carbolfuchsin. It is Gram-negative and anaerobic. In stained preparations vacuoles are often seen, and frequently spore-like bodies can be made out if a film is stained by warm carbolfuchsin and decolorized in one per cent sulphuric acid. Tunncliffe [30] states that "spores can be seen in the first days of a growth situated at one end or near the centre of the bacillus, and the development from the spore into the very short plump bacillus may be observed in a hanging drop."

The spirochæte is a delicate organism about twelve microns to thirty microns in length. It usually has five or six undulations of wide amplitude. It is quite distinct from the *Treponema pallidum*, which is finer, with eight, ten or more undulations.

The *Spirochæte vincenti*, as it is frequently called, is motile, and takes the stains like the fusiform bacillus. It is Gram-negative and anaerobic.

The fusiform bacillus and spirochæte may be easily displayed by the following simple procedure: A smear is made from a fuso-spirochætal ulcer, dried, fixed, stained for a few minutes in diluted carbolfuchsin, dried and examined under the oil immersion lens, when fusiform bacilli and spirochætæ will be seen usually in great profusion mixed up with cocci, bacilli, leptothrices, and other organisms.

Sometimes in severe cases almost pure cultures of fusiform bacilli and spirochætæ will be found, but these will gradually decrease in numbers as the process of recovery advances.

It should also be mentioned that some smears from a healthy mouth fixed, stained and examined microscopically, show quite a different picture from smears from a fuso-spirochætal ulcer of the gums, throat or mouth. In the former the fusiform bacilli, if present, are few and far between, while in the latter they are numerous.

CULTIVATIONS.

From the throats or gums of patients affected with fuso-spirochætal ulcerations the undermentioned culture media were inoculated: Serum agar (one in three), serum broth, broth, agar, Noguchi's kidney and broth medium, ordinary serum, nasga and trypsin agar.

The following simple method was usually adopted: The test tube containing the medium was inoculated, the wool stopper pushed down the tube, on the top of this pyrogallie acid and liquor potassii were added, and a well-fitting india-rubber cap slipped over the mouth of the test tube, melted wax was then added over and around the cap and the test tube incubated at 37° C. for two, three, four or five days.

By the above method I obtained the best results from growing the *B. fusiformis* in serum broth and serum agar. The growths were always contaminated with cocci or streptococci or both, and all attempts to obtain a subculture failed. The colonies obtained on serum agar were small streptococcal looking but white. The media giving a growth of fusiform bacilli always had a very foul smell. Ellermann [16], Tunncliffe and Weaver [12] and others claim to have obtained pure growths of the fusiform bacillus on serum agar. In one tube of serum broth inoculated from a case of Vincent's angina I found two or three spirochætæ still active after four days' incubation at 37°C., but I was unable to decide whether there was a true growth. Muhlen and Hartmann [17] claim to have grown the spirochæte in pure culture, while Tunncliffe [30] states she has grown the spirochæte from the fusiform bacillus. Most observers, however, maintain they are entirely distinct organisms.

Helen P. Goodrich, D.Sc., and M. Moseley [31], in a paper recently published by them, describe a fusiform bacillus growing from a leptothrix forming what they call "bottle brush branches." These branches were only found on extracted teeth from advanced cases of pyorrhœa. It remains to be proved whether they are identical with the fusiform bacillus of Vincent's angina and allied affections. I find the above form of leptothrix was described as early as 1908 by Theo. von Beust [18].

INOCULATIONS.

Ellermann [19] injected pure cultures into rabbits, and produced small abscesses. Hultgens [10] reports inoculations of pure growths into the peritoneal cavity of guinea-pigs, white rats and wild rats with negative results. The fusiform bacilli were recovered from the peritoneal fluid thirty days after inoculation but there was no sign of growth and no pathological conditions were visible in these animals.

Inoculations of the false membrane from cases of Vincent's angina beneath the skin or into the muscles of laboratory animals usually produce abscesses and ulcerating foci of necrosis in which the *B. fusiformis*, with many other organisms, are found [20].

Inoculation of fusiform bacilli and at the same time of 1 in 5 solution of lactic acid stimulate the formation of lesions and the growth of the bacillus [20].

Possibly the *B. fusiformis* requires ancillary organisms or damaged tissues like the *B. tetanus* before it produces its pathological effects, for inoculations of pure cultures of fusiform bacilli from whatever source are generally followed by negative results. Here it is interesting to recall the fact that twelve of my cases occurred after having teeth extracted or scaled by dentists.

PATHOLOGY.

Fuso-spirochætal affections of the mouth and throat are characterized by the formation of membranous ulcers which Vincent classified into two

types, both of which he fully described. I shall briefly mention their chief characteristics.

(a) The ulcero-membranous or deep type is by far the more frequent, and is found on the gums, tonsils, cheek, hard and soft palate and pillars of the fauces. It is usually covered by a thick, soft, creamy, membranous substance easily removed by a throat swab or any blunt instrument. The edges of the ulcer may be irregular or punched out, and the ulcer may extend deeply into the tissues or remain superficial. It has a red, angry look and bleeds under the slightest provocation, such as a light touch with a platinum loop.

Examined microscopically, the membranous exudate is seen to be composed chiefly of granular material in which may be seen a few leucocytes and many fusiform bacilli and spirochætæ and other organisms, as cocci, bacilli and leptothrices, in more or less abundance. Sometimes it presents an appearance of a pure culture of fusiform bacilli and spirochætæ.

(b) The superficial or diphtheroid type of ulcer—so called from its close resemblance to diphtheria—is characterized by the membrane covering the part being thin, white, or greyish-white in colour and very difficult to remove. If removed a red bleeding surface is left.

A smear from the membrane dried, fixed, stained with weak carbol-fuchsin and microscopically examined, will be found to consist chiefly of fibrin, many fusiform bacilli and spirochætæ. If the membrane is hardened, sections cut, stained with carbol-fuchsin and examined microscopically, it will be found to consist of a network of fibrin entangling a few leucocytes and fusiform bacilli often in closely packed clusters and sometimes forming a dense stratum through the section.

I shall describe the fuso-spirochætal affections of the buccal cavity and throat in the following order, taking those of the gums first because these are by far the most frequent, and, as far as my experience goes, always accompany and precede infection of the other parts invaded:—

- (1) Affections of the gums.
- (2) Affections of the tonsils (Vincent's angina).
- (3) Affections of the mucous membrane of the buccal cavity.

FUSO-SPIROCHÆTAL AFFECTIONS OF THE GUMS.

The gums are affected nearly three times more frequently than the tonsils. During the last twelve months I have attended over 350 cases. In all cases the ulcers conformed to the deep type—the soft membranous exudate was easily removed, leaving a bleeding surface. The form of ulceration most frequently met with is confined just to the tops of the gums as a thin narrow line around the necks of the teeth. The gums around one or many teeth may be involved. To this variety the name, “peridental ulcerative gingivitis” [28] has been given.

Sometimes the ulceration may affect only the tops of the papillæ between the teeth, at other times it may involve the surface of the gums

to the extent of a quarter of an inch (a typical ulcero-membranous type), or it may eat deeply into the gums and form deep excavations usually filled with a soft creamy exudate. The last form is common behind the lower molars, and occurred in forty-five of my cases. This form of ulceration frequently extends laterally, involving the cheek.

The gums are usually swollen, retracted, and separated from the teeth, and bleed under the slightest provocation. Sometimes the ulceration is so small, as in the peridental type, that it is very difficult to detect; its presence, however, can easily be revealed by lightly rubbing over the tops of the gums a small pledget of cotton wool, when small bleeding points will indicate the denuded parts.

Pain, bleeding, foul breath and nasty taste in the morning are usually complained of. There is as a rule no rise of temperature or constitutional disturbance. The pain may be so severe as to prevent mastication. The bleeding is most noticeable when the teeth are brushed. In many of the cases the patients were compelled to discard the toothbrush on account of the pain and bleeding excited.

The foul breath is somewhat characteristic but not always noticeable. When the ulceration is confined to the tops of the gums about the necks of the teeth (peridental type), the submaxillary lymphatic glands are not affected; but when the ulcers are deep and extensive I have always found the lymphatic glands enlarged and tender.

The ulceration may attack any part of the gums and extend along the whole of the upper and lower. The ulceration, however, is most frequently found about the necks of the lower incisors, the back molars, stopped or capped teeth, and at the tops of papillæ between irregular teeth.

Some cases develop in a few days and may involve the whole of the upper and lower gums (acute cases). The pain and bleeding in these are severe and call for early treatment.

Most cases are chronic and have been running for weeks, months or even years; in these the pain and bleeding are not so severe, but looseness of the teeth has been complained of. The peridental membrane was certainly affected in some of the chronic cases as radiographs showed considerable alveolar absorption. In one case of deep ulceration the dentist extracted a tooth, and smears from the apex of its root fixed, stained and microscopically examined showed fusiform bacilli. The root may, however, have become infected during extraction.

From my investigations there is every reason to believe that the so-called "trench gum" occurring among the soldiers in France is identical with this affection.

Several cases invalided home and diagnosed at the front as "trench gum" have been examined by me and found to present the typical clinical appearances, and the microscopic findings have always revealed the presence of the fusiform bacilli and spirochaetæ in abundance.

Lieutenant D., invalided home two weeks ago, came for treatment on

account of a sore throat of three days' duration. He said during the last six months he was in France his gums were painful and bleeding and he was told he had "trench gum." I found a deep ulcer on his left tonsil and along the lower gums typical fusospirochætal ulceration. The sub-maxillary lymphatic glands about the left angle of the lower jaw were enlarged and painful.

Smears from the throat and gums showed microscopically many fusiform bacilli and spirochætæ. Many similar histories of cases might be recorded, but as they are practically reflections of the one given their repetition is unnecessary.

Diagnosis.—The only condition this disease is likely to be mistaken for is pyorrhœa alveolaris, and this diagnosis was made and the extraction of the teeth advised in many of my cases. The fusospirochætal affection is distinguished by the character of the ulceration, its liability to bleed, foul breath and pain. Moreover there are no pus pockets present as found in pyorrhœa alveolaris. Looseness of the teeth may be complained of and if an X-ray photo of the gums of these cases is taken, absorption and rarefaction of the alveolar border will most likely be found, but pus can never be squeezed up between the tooth and gum unless pyorrhœa alveolaris is also present.

The above mentioned clinical findings, corroborated microscopically by the finding of many fusiform bacilli and spirochætæ, complete the diagnosis.

Duration of the Disease.—Most of the cases under treatment get well in about three weeks, some in a shorter period; while a few—particularly those with irregular teeth, those where the disease has been present for a long period, and those wearing a dental plate, or where the disease cannot be regularly treated—run into months.

Complications.—The chief and most frequent complication is Vincent's angina, which was present in 157 cases out of 319. In three cases I have met with herpes labialis, and in one case red blood cells in the urine.

Relapses.—These are frequent if every trace of the disease has not been thoroughly eradicated. In a few, where smears from the gums have shown no trace of the fusiform bacillus, the disease has reappeared; but in the large majority, when the fusiform bacillus has been proved absent, the gums have remained free from any recurrence.

Treatment.—It is of the greatest importance to have the teeth well attended to. If necessary these must be thoroughly scaled and polished. It may not be possible to carry this out at first owing to the extreme tenderness of the gums. In such cases it is best to treat the gums for a few days with some antiseptic, when the tenderness will gradually lessen and permit the dentist to carry out the operation. Two or three sittings may be necessary to completely remove all tartar. I always insist on the frequent use of a mouth-wash such as peroxide of hydrogen or carbolic acid and chlorate of potash, particularly after meals, so as to wash away all particles of food. A soft toothbrush should be used if possible with an

antiseptic solution. The toothbrush should be kept in an antiseptic fluid when out of use, so as to keep it soft and clean, and thus prevent injury to the new tissues. When the gums are healed a new toothbrush should be obtained.

All cases should be informed of the infectious nature of the disease, and proper precautions taken to prevent it being transmitted to others by kissing, pipes, cigarette holders, etc. I always swab the gums daily or twice daily with an antiseptic. Among other things tried are tincture of iodine, colloidal iodine, colloidal silver, bacterol, flavine, and a mixture of vinum ipecacuanha 3ss, glycerine 3i, liquor arsenicalis ad 3i; but none gave such good results as an alkaline salvarsan solution double the strength ordinarily used for intravenous injections. This remedy was tried owing to the success attending its use in Vincent's angina. In this affection the salvarsan powder was simply dusted on the part by some, others swabbed it on mixed with glycerine. Ehrlich [26] tried salvarsan intravenously, but Citrol [27], who used both the local and intravenous methods, thought the former more efficacious. Before each swabbing I carefully dry the gums with cotton wool and pick out all extraneous matter from between the teeth with a dentist's probe.

The above treatment is continued daily or twice daily until smears from the gums show no fusiform bacilli and every niche and corner of the gums after careful examination show no bleeding points. No case should be discharged as cured until all traces of the disease have been eradicated. In no case has it been found necessary to extract the teeth to attain this end.

The following cases illustrate the characteristics of the affection:—

August 15, 1916. Lieut. C. R. F. Br., was sent to me by Sir F. F., on account of sore gums. There was a deep ulcer involving the gum behind the right lower wisdom tooth and extending superficially over the gum and right up the cheek over an area of the latter for about one square inch. The deep ulcer behind the molar was filled with a soft creamy exudation and the rest of the ulcerated patch covered with a thin greyish membrane. The tops of the upper and lower gums were also ulcerated and over these parts was a thin greyish exudate easily removed. The teeth were complete and in good condition. He said his mouth had been sore and bleeding since the beginning of June, 1916, and from that time up to the present he has been treated by ionization, paints, mouth washes, etc. The ionization gave him quick relief, but when this was discontinued for a few days the soreness of the mouth returned. The lymphatic glands at the angles of the jaw were enlarged and tender. His breath was very offensive. The ulcerated parts bled freely when lightly touched. Smears from the cheek and gums fixed, stained with dilute carbolfuchsin and microscopically examined showed fusiform bacilli and spirochætæ in abundance.

Urine.—No albumin. Few red blood cells.

Treatment.—Ulcerated parts were dried with cotton wool, and then lightly swabbed over with salvarsan solution. A mouth-wash of liq.

hydrarg. perchlor., pot. chlor. and glycerine was prescribed to be used frequently. The swabbing caused great pain and bleeding. August 16, 1916: The ulcerated parts were still covered with a greyish membrane, but the patch on the cheek appeared smaller. A small ulcer was now observed behind the left lower molar. The ulcerated parts were freely swabbed twice to-day. August 17, 1916: Patient said his mouth was much more comfortable. The swabbing still caused much pain and bleeding. August 18, 1916: Breath not so offensive. The ulceration on the cheek decidedly smaller. Mouth not so tender when painted. August 19, 1916: Mouth feels very much better. The ulcer on the cheek is now red and free from membrane, and so were several parts of the gums. The tenderness was much less when parts were swabbed. August 20, 1916: Gums improving, but still bleed freely when swabbed. August 24, 1916: Gums swabbed with one per cent solution of flavine. August 30, 1916: Gums have continued to improve. Flavine solution has been freely applied each day. Most of the ulceration is healed, but small tender, bleeding ulcers still remain in several spots between the upper molars and lower incisors. Urine free from red blood cells. August 31, 1916: Gums to-day show no improvement, so they were swabbed with a mixture of arsenic, vin. ipecac. and glycerine. This treatment was continued daily till October 2, 1916, when there still remained a small ulcer at the top of the gum between the lower canine and left second incisor.

At this date the officer was ordered to rejoin his unit.

Smears were taken and examined on many occasions during his attendance, and always found positive. On the date he was recalled very few fusiform bacilli could be found. The ulceration in this case was severe and intractable, and the treatment not so successful as in most cases. I have no doubt, unless his gums are regularly treated, the disease will quickly relapse.

November 4, 1916: Captain H. came for treatment; he said he had been troubled with sore and bleeding gums for eight weeks. A dentist he consulted told him he had pyorrhœa, and he must have his teeth extracted. To this he objected, so the dentist tried treating his gums with carbolic acid and tincture of iodine. After the effects of these applications had passed off he found his gums as bad as ever. His teeth were in good condition. The two left lower bicuspid were stopped with gold and the first upper right molar gold capped. The tops of the gums about these teeth were ulcerated, and there was a deep ulcer filled with a soft, creamy exudate behind the left lower wisdom tooth, and there was peridental gingivitis about the necks of the lower central incisors. The lymphatic glands about the left angle of the jaw were enlarged and tender. Smears from the ulcerated parts examined microscopically showed many fusiform bacilli and spirochætæ. Urine normal. A mouth-wash of peroxide of hydrogen was ordered to be used frequently. The usual instructions given concerning the toothbrush, and the gums dried and then swabbed with

salvarsan solution. November 20, 1916: Ulcer behind lower wisdom tooth quite healed, only a small bleeding spot on the top of the papilla between the lower central incisors to be found. November 24, 1916: Treatment carried on till to-day when gums were quite healed, and no fusiform bacilli could be found microscopically.

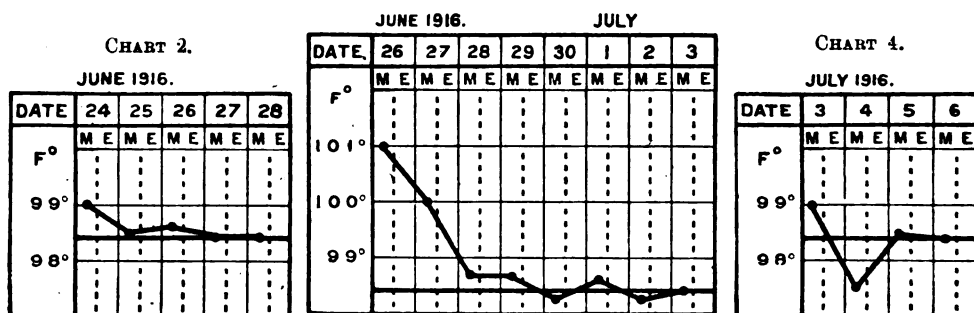
The first case is a good example of a type occasionally met with which run a chronic and refractory course, and this case moreover is the only one in which I met with red blood cells in the urine.

FUSO-SPIROCHÆTAL AFFECTIONS ON THE TONSILS, SO-CALLED VINCENT'S ANGINA.

Vincent's angina in my series of 157 cases was always accompanied with fuso-spirochætal ulceration of the gums. In the majority of cases the form of ulceration affecting the gums was of the peridental type; in the remainder the ulceration was more extensive (typically ulceromembranous).

In not a single case of Vincent's angina have I failed to find the gums affected, and what is more, almost every case on inquiry disclosed the fact that the gums were affected prior to the tonsils, and it certainly appeared

CHART 3.



as if the tonsils became infected from the gums. Moreover this sequence of events is supported by many cases (twenty) where the gums remained unhealed and the tonsils became re-infected and ulcerated.

Further it is interesting to recall that the rise and fall of the numbers of cases of Vincent's angina met with during the year 1916 were synchronous with those of the gums.

Symptoms.—The patient rarely looks or feels ill. He usually complains of pain or discomfort in the throat increased on swallowing, occasionally darting up to the ears. He may have headache and indefinite pains in the limbs. The temperature very rarely exceeds 100° F., and when raised usually subsides in a day or two. The pulse-rate simply shows the usual relationship of fluctuations to temperature. The small amount of constitutional disturbance found is surprising, and forms a strong point

in the diagnosis of the affection. The lymphatic glands about the affected region are enlarged and tender. As a rule the mouth can be easily opened, when the hard and soft palate will often be seen to be red or injected. If the tonsils are examined one of two conditions will usually be found.

(a) On the surface of one or both tonsils will be seen a soft whitish creamy-looking membrane which can easily be removed with a swab, leaving behind a deep ragged or punched-out ulcer with a bleeding base. This is the deep type of ulcer.

(b) Or you will find a thin whitish membrane covering part or both tonsils, very difficult or impossible to remove by gentle brushing, but if removed leaving a bleeding ulcer. This is the diphtheroid or superficial type of ulcer.

In 150 cases I found the right tonsil affected in 66 cases; left tonsil affected in 36 cases; both tonsils affected in 48 cases. In 150 cases I found 120 cases the ulcers were of the deep type; 30 cases the ulcers were of the diphtheroid type.

The membrane if removed is found to have a very foul smell, and the same foetor is noticeable about the breath of the patient.

Some ulcers are very acute and may extend rapidly in surface and depth. I have seen an ulcer increase half an inch in depth in twenty-four hours. The diphtheroid or superficial ulcer may cover both tonsils, pillars of fauces and soft palate presenting an appearance very like diphtheria and frequently mistaken for it. The deep ulcer may similarly encroach on the parts adjoining the tonsils.

The urine is usually normal.

In six of my cases albuminuria was present, and in eleven, including the above six, red blood cells were found. Renal casts were found in one case.

The Blood.—In a few cases, particularly where the temperature was raised, there was an increase in polymorphonuclears. In about ten per cent of the cases examined I found an increase of hyalines, occasionally reaching twenty-one per cent in a differential count, which fact is interesting considering the protozoon present in the infection.

Duration of Disease.—Most of the cases recover in ten or eleven days. The average duration of 150 cases was fifteen days. Ulcers of the deep or ulcero-membranous type tend to recover more quickly than the diphtheroid or superficial type.

The affections of the throat and soft parts of buccal cavity nearly always recover more quickly than the gums.

Complications.—The chief and most important is ulceration of the gums. This as already stated was found in every case, and as the tonsil most likely becomes infected from the gums the importance of recognizing the connexion must always be borne in mind in carrying out treatment. For unless the disease is thoroughly eradicated from the gums the affection is likely to reappear in the tonsil. Many of the cases attended gave

288 *Fuso-Spirochætal Affections of the Mouth and Pharynx*

histories of recurrent sore throat, and the tonsils of some of the cases presented a pitted, ragged appearance, bearing testimony to their statements. As already mentioned, albumin, red blood cells, and tube casts have been found in the urine. Klebs-Löffler bacillus was found co-existing in eleven cases, syphilis in two—both cases corroborated by positive Wassermann reactions.

Sequelæ.—The only sequela met with following the disease was slight general weakness.

Recurrence.—The affection recurred in twenty cases, and there were reasons to believe the re-infection of the throat in every case was due to fuso-spirochætal ulceration of the gums. The gum ulceration usually met with in these relapsing cases is of the peridental type, which, owing to the small amount of the gum affected, is liable to be easily overlooked.

Diagnosis.—In the majority of cases the diagnosis can be made with reasonable care from the clinical appearances alone, but to be on the safe side a direct smear should be fixed, stained with weak carbolfuchsin or methylene blue and examined under the high power ($\frac{1}{12}$) for fusiform bacilli and spirochætæ. The presence of co-existing diphtheria and syphilis must never be lost sight of. From every one of my cases cultures were made on ox serum slopes and incubated at 37° C. for twenty-four hours and then examined for the Klebs-Löffler bacillus.

The chief clinical features of Vincent's angina are:—

- (1) Slight constitutional disturbance.
- (2) Temperature rarely over 100° F.
- (3) Pain on swallowing.
- (4) Submaxillary lymphatic glands enlarged and tender.
- (5) Disease often unilateral.
- (6) The membranous exudate is usually easily removed, leaving a raw bleeding surface.

(7) Urine rarely albuminous.

(8) Presence of fusiform bacilli and spirochætæ.

In diphtheria we have a membranous formation accompanied by:—

- (1) Severe constitutional symptoms.
- (2) Both sides of the throat affected (usually).
- (3) Pain on swallowing not great.
- (4) Submaxillary lymphatic glands not so tender.
- (5) Membrane difficult to remove.
- (6) Albumin frequently present in the urine.
- (7) Klebs-Löffler bacillus present in culture.

Fusiform bacilli and spirochætæ may be found in syphilitic ulcers, but the ulcer has not the clinical features of the true Vincent's angina. The lymphatic glands are not enlarged and tender and a Wassermann reaction of the blood will settle the question.

The presence of positive Wassermann reactions apart from concomitant syphilis has been reported by Gerber [22], Much [23], Saverio [24], and Sobernheim [32].

In the case reported by Much the blood gave a positive reaction during the febrile period of the disease, but a fortnight later when the angina was cured the reaction was negative.

Sir StClair Thomson [25] writes: "From syphilis the diagnosis is more difficult, as both fusiform bacilli and spirilla may be found in a cover-glass preparation from a tertiary ulcer, and also because apart from concomitant syphilis the Wassermann reaction may be positive."

The Wassermann reaction of the blood was taken in thirty unpicked cases from my series, and was negative in all but two, both of whom admitted to having had chancres ten years ago.

From my uniform negative findings I can only conclude that latent syphilis must have been overlooked in those recorded cases giving a positive reaction, or the technique of the reaction was faulty. It is to be remembered the findings reported by Gerber, Much, Saverio and Sobernheim were made in the early days of the Wassermann reaction.

Here the following case, one of the two in which syphilis co-existed with Vincent's angina, is worth recording:—

December 14, 1916.—Pte. G., an Australian, attended the hospital suffering from a typical superficial ulceration of the right tonsil of one week's duration. His temperature was normal. His right submaxillary lymphatic glands were swollen, his breath foetid, and his teeth dirty and tartrated. The gum lines along the upper and lower teeth were ulcerated and covered with a soft creamy exudate. Smears from the tonsil and gums suitably prepared and microscopically examined showed many fusiform bacilli and spirochætæ. He was first referred to the dentist to have his teeth scaled and polished. The ulcers were then treated and the tonsil healed in six days. He still continued to attend for treatment for his gums. December 24, 1916: An indolent-looking ulcer was noticed on his left tonsil, and smears prepared from this and microscopically examined showed a typical picture of Vincent's organisms. It was noticed, however, that the left submaxillary lymphatic glands were not enlarged or tender, and that the ulcer when touched did not bleed. On inquiry he admitted to a chancre ten years ago, and his blood gave a strong positive Wassermann reaction.

The diagnosis of Vincent's angina from the ordinary acute tonsillitis can usually be easily made from the severe constitutional symptoms accompanying the latter.

Treatment.—The local treatment applied to Vincent's angina is the same as that for the fuso-spirochætal affections of the gums, and as they are always co-existent this is easily carried out. There are, however, one or two obvious facts to be borne in mind, if there is a rise of temperature or albumin present in the urine the patient should be put to bed and a light milk diet ordered.

The precautions already laid down in "Treatment of the Gums" respecting the use of the toothbrush and the infectious nature of the disease must be carried out.

The following histories represent the types of cases met with :—

November 1, 1916. Pte. G. complained of sore throat of twenty-four hours' duration. Temperature normal ; pulse 70. The lymphatic glands at the left angle of the jaw were enlarged and tender and there was pain on swallowing. The left tonsil was covered with a thin greyish membrane easily removed, and there was a peridental ulceration along the tops of the gums about the necks of the lower incisors. His teeth were sound and in good condition, but he volunteered the statement, "his gums had bled badly for the last week when brushed." Touching the tonsil and gums with a platinum loop caused them to bleed. Smears from the tonsil and gums were fixed, stained and microscopically examined, and many fusiform bacilli and spirochætæ found. Urine normal.

Blood.—Red blood cells, 6,200,000 ; white blood cells, 7,125 ; polymorphs, 75 per cent ; small lymphocytes, 21 per cent ; large lymphocytes, 4 per cent. Wassermann reaction of the blood gave a negative result. Treatment was carried out on the lines already laid down and a salvarsan solution applied to the throat and gums. November 6, 1916 : Throat and gums have been treated daily up to date—both are much better—the tonsil almost well. A deep ulcer has appeared at the top of the left anterior pillar of the fauces. The sides of the ulcer are irregular and the tissues around are red and swollen. The ulcer was about half an inch deep, and filled with a soft creamy exudate. Smears from this showed many Vincent organisms. The same treatment was continued to all three ulcers and the throat and deep ulcer on pillar of fauces were healed by November 6, 1916. The gums, however, were not healed and free from fusiform bacilli until December 5, 1916.

July 3, 1916 : Lieutenant D. complained of sore throat, increased on swallowing and headache. His face was flushed. Temperature 99° F. Pulse 80. The lymphatic glands about the right angle of the jaw were enlarged and tender. He opened his mouth without any difficulty, and on the top of the right tonsil a whitish patch could be seen which was easily removed by a platinum loop, leaving a deep ragged bleeding ulcer. The teeth were in good condition, but the tops of the gums about the lower incisors and right upper molars were ulcerated. *Blood* : White blood cells, 4,575 in one cubic millimetre. *Differential Count* : Polymorphs, 73 per cent ; hyaline, 11 per cent ; lymphocytes, 16 per cent. The urine contained a trace of albumin and a few red blood cells. Smears from the right tonsil and gums contained many Vincent organisms. A gargle and mouth-wash of peroxide of hydrogen was ordered to be used frequently, and the gums gently dried and swabbed over with salvarsan solution. July 4, 1916 : Pain on swallowing less. Flushed appearance gone. Temperature 97° F. Pulse 72. Exudate over the tonsil had reformed. Treatment continued. July 5, 1916 : Pain in throat gone. Submaxillary glands almost painless to touch. Exudate over ulcer of tonsil reformed, but was much smaller. Smears showed fewer fusiform bacilli and spirochætæ.

Urine : Albumin 0·2 per cent. Few red blood cells and few hyaline casts. July 6, 1916 : Patient says he feels well. Temperature 98·6° F. Pulse 70. Patch on right tonsil smaller. *Urine* : No albumin ; no casts ; few red blood cells. July 7, 1916 : Temperature 98·6° F. Ulcer on tonsil almost healed ; no white patch to be seen. Lymphatic glands about angle of jaw can only be felt with difficulty. *Urine* : 0·5 per cent albumin ; no casts ; few red blood cells. July 8, 1916 : Ulcer on tonsil healed. *Urine* : No albumin ; no casts ; few red blood cells. July 9, 1916 : The gums had been treated daily and were now much better. *Urine* : No albumin ; no casts ; no red blood cells.

The progress continued and the gums were treated till July 16, 1916, when smears from them showed when examined microscopically no fusiform bacilli.

The above recorded cases reflect, except in a few minor and unimportant details, the rest of the cases met with. The same sequence of events is repeated time after time, first the sore and ulcerated gums, followed by ulceration of the tonsils.

To some the ulceration of their gums was unknown and had to be sought, others knew of the pain and bleeding but thought them not worth mentioning, while in many the ulceration was too painful and inconvenient to be ignored. So far I have not met a single case of Vincent's angina where the gums have been found free from fuso-spirochætal ulceration.

FUSO-SPIROCHÆTAL AFFECTIONS OF THE MUCOUS MEMBRANE OF THE BUCCAL OR MOUTH CAVITY.

Fuso-spirillary ulcerations of the mucous membrane of the mouth cavity are rare compared with the frequency they affect the tonsils and gums. During the year 1916 I only met with seven cases where the ulceration was not continuous with a similar ulceration of the tonsils or gums.

In every one of those cases there co-existed ulceration of the gums, and the histories when obtainable repeated the sequence found in Vincent's angina, namely, that the gums were affected prior to the mucous membrane. The parts of the mucous membrane mostly affected were, in the order of their frequency, soft and hard palate, anterior pillars of the fauces and cheek about the buccal space opposite the molars. I have never met with any fuso-spirochætal ulceration of the tongue.

The ulcers may be deep or diphtheroid ; the former variety is certainly the more common, but ulcerations of the diphtheroid type occur more frequently than on the tonsil. In my seven cases two were diphtheroid and five of the deep or ulcero-membranous type.

Sometimes the ulcers remain small and deep and tend to perforate the part, or they may extend over large areas and involve the hard and soft palate or an extensive part of the cheek. I have never met with an

ulceration with the clinical appearance of noma. The signs and symptoms of the affection in these parts are as characteristic as when the tonsils are affected. There is very little constitutional disturbance, but there is foetor of breath, pain, great tenderness and membranous formation over an area easily excited to bleed. The lymphatic glands are usually enlarged and tender. The physical appearances of the affected part often suggest diphtheria or syphilis. The course, duration, complications and sequelæ are the same as found in the tonsillar affection. The histories of a few cases will make these points clear.

July 13, 1916 : Captain S., a Canadian, complained of headache, sore throat, and feeling ill. Temperature, 99·4° F.; pulse, 60. Lymphatic glands about the right angle of jaw were swollen and tender. There was a thin greyish membrane about the size of a halfpenny over the right side of the soft and hard palate and the parts about the membrane were red, swollen, and sodden looking. The membrane could not be removed by lightly brushing with a swab. There was peridental ulceration of some weeks' standing about the lower incisors. The tonsils were not affected. Smears from the membrane on the palate and from the gums, fixed, stained and microscopically examined showed many fusiform bacilli and spirochætæ. Cultures were also made on ox serum and incubated at 37° C. for twenty-four hours. The urine was free from albumin but contained a few red cells. A blood count showed nothing abnormal. A mouth-wash of peroxide of hydrogen was ordered to be used frequently, and the palate and gums were freely swabbed with salvarsan solution. July 14, 1916 : No Klebs-Löffler bacillus found on ox serum growth. Temperature 98·6° F. Patient says he feels worse. The palate looks much the same, but the tissues around the membrane are not so swollen. A deep ulcer has now formed on the gum behind the right lower wisdom tooth. Treatment continued. July 15, 1916 : Patient complains of great pain in the mouth, and will not allow any swabbing. The palate and gums appeared very much the same except a small black slough had formed over the soft palate. Temperature to-night rose to 101·2° F., and as he complained of pain and sleeplessness morphia $\frac{1}{4}$ grain was given subcutaneously. Urine: No albumin; a few red blood cells. July 16, 1916 : The membrane on the palate is larger. Patient says he feels a little better. Temperature 99·2° F. July 17, 1916 : Patient feels a little better. Mouth looks much the same; still too tender for swabbing. July 18, 1916 : Patient feels very much worse, so he was seen in consultation with Mr. Potter, laryngologist, and Colonel Pasteur, F.R.C.P.; the former expressed the opinion that the mouth condition was most likely specific. Blood taken for Wassermann reaction, and he was afterwards given a mixture of liq. hydrarg. perchlor. and pot. iod., and the mouth-wash changed for one of liq. hydrarg. and pot. chlor. July 19, 1916 : Wassermann reaction negative. Patient much the same. July 20, 1916 : The membrane on palate is separating. Patient says he feels better. Swabbing the gums and palate with salvarsan solution resumed. Smears

from palate show many fusiform bacilli and spirilla. July 21, 1916: The palate is almost clear of membrane and ulcer is beginning to heal. Patient very much better. From this date he made a steady and rapid progress, and was discharged on July 30, 1916, when the fusiform bacilli were found in smears from the gums. The gums were several days healing after the palate had recovered.

Finally, I quote the following case—although incomplete in many details—because of its rarity, treatment and sequelæ, and more particularly because it embodies a few points mentioned by previous writers on Vincent's angina, but as yet untouched by me.

Nurse A. was taken ill at King George Hospital, on August 7, 1916, and the following short report was sent by the medical officer of that institution, when she was transferred to an auxiliary hospital of Queen Alexandra's Military Hospital.

"Nurse A. complained of sore throat. Temperature, 101.4° F.; pulse, 120. Left tonsil inflamed and covered with a thick whitish-yellow membrane. Patient looked ill. Swab taken from the throat. She was put to bed, ordered calomel grains 2½ and mixture of liq. hydrarg. perchlor., gargles and foment. 10.30 a.m., August 8, 1916: Throat looking much worse. Membrane extended and greyish-dark in colour, uvula and tissue between uvula and left tonsil infiltrated. Swab-growth from serum showed few rods and cocci. No Klebs-Löffler bacillus. Treatment continued. Diphtheria antitoxin 12,000 units given as a precaution. 5 p.m.: Patient looking worse. Membrane darker in colour and more extensive. Condition regarded as severe infection—probably septic—exact organism not known. Has been nursing patient with similar throat who died August 6, 1916. She was now transferred to Vincent Square Hospital, where I was asked to see her and examine swabs from her throat. On admission her throat was found as described: Palate and uvula very swollen and infiltrated and covered with a large black-looking slough; her breath was very offensive and the submaxillary glands enlarged, painful and tender. Temperature, 103° F.; pulse 108. Ordered antiseptic gargles and inhalations. August 9: Passed a fair night and seems a little better. Direct swabs show a mixed infection of Vincent's organisms and many streptococci. Ox serum growths produced no Klebs-Löffler bacillus.

"On the advice of Captain McKinstry, who examined the patient and swabs, a gargle of liq. hydrarg. perchlor. and pot. chlor. with glycerine; mixture of tinct. ferri perchlor., and a subcutaneous injection of 100 millions of sensitized streptococcal vaccine were ordered.

"August 10: Improved; much less œdema in throat. Slough separating. 250 millions of sensitized streptococcal vaccine given subcutaneously. August 11: Patient passed a good night and is much more comfortable. Œdema and swelling greatly lessened; slough coming away. 500 millions of sensitized streptococcal vaccine given. August 12: Patient much improved. 1,000 millions sensitized streptococcal vaccine given. August 13:

Patient very much improved and most of the slough has come away. Urine, albuminous and shows microscopically epithelial, hyaline and granular casts and red blood cells. September 8: Patient continued to improve and was able to take short walks. To-day she complained of difficulty of swallowing. Paralysis of the ciliary and palatal muscles was found. Patient put back to bed. Swabs again taken from the throat. Smears were stained and microscopically examined; no Vincent's organisms found. Serum cultures were made and incubated at 37° C. for twenty-four hours. No Klebs-Löffler bacillus found. September 25: Palatal paralysis has gradually increased. Voice nasal and speech slurred. There is now slight paresis of hands and feet; loss of sensation to touch and pain in both feet and numbness of fingers; knee and plantar reflexes absent. September 26: Seen to-day by Colonel Pasteur, F.R.C.P., who confirmed the above condition and ordered a mixture of liq. strych. hydro. ch. m v, tinct. bellad. m x every four hours. December 25: Convalescence has been gradual and uninterrupted. All paresis, motor and sensory, is now gone. Urine shows only a trace of albumin; no casts. Patient sent to a convalescent home."

The smears from this case in the early part of the disease showed Vincent's organisms, but the picture of the films was not the one usually obtained from Vincent's angina, the fusiform bacilli were few and far between, and the line of treatment pursued was suggested by the abundance of streptococci present.

Paralysis of the ciliary and palatal muscles, loss of knee-jerks and ataxia have been recorded following infections of Vincent's organisms.

In the series of my cases I have not met with any nerve complication or nerve sequela. The paralyses following the acute course of the above case at once suggest diphtheria, but ox serum smears were made, incubated and examined by me and others with negative results.

Osler [29] writes: "Occasionally paralyses follow streptococcus tonsillitis which are identical with those of diphtheria"; and I think from the success which followed the administration of the sensitized streptococcal vaccine in the above case we are justified in concluding it a streptococcal infection. The high temperature and severe constitutional disturbance were in themselves sufficient to separate it from Vincent's angina. Moreover after reviewing all my cases I cannot help feeling sceptical concerning the recorded cases of paralyses following a true Vincent's angina. The co-existence of diphtheria and Vincent's organisms, which has already been referred to, might be easily overlooked, but not more easily than associated streptococcal infection.

In conclusion I should like to state that the diagnoses of all my cases have been confirmed microscopically, and also the fact that ox serum inoculations were made, incubated for twenty-four hours and afterwards examined microscopically for Klebs-Löffler bacillus.

The points I have attempted to bring out in this communication may be epitomized under three heads.

- (1) The different varieties of fuso-spirochætal ulcerations of the gums.
- (2) The invariable association of fuso-spirochætal ulceration of the gums with Vincent's angina and allied affections of the mouth cavity.
- (3) Vincent's angina and the allied ulcerations of the mouth cavity are always secondary to fuso-spirochætal ulceration of the gums.

REFERENCES.

- [1] BABES. *Deutsch. med. Wochenschr.*, 1893, Nr. 43.
- [2] MILLER. *Ibid.*, 1888, Nr. 30.
- [3] PLAUT. *Ibid.*, 1894, Nr. 49.
- [4] VINCENT. *Ann. de l'Inst. Past.*, 1896, 1899. "Sur une forme particulière d'angina diphtheroid," *Soc. med. des Hôp.*, March 17, 1898. "Nouvelles recherches sur l'angine à bac. fusiform," *ibid.*, January 12, 1899.
- [5] ROLLESTON, J. D. *Brit. Journ. Children's Dis.*, July, 1910, p. 299.
- [6] BRUCE, H. W. *Lancet*, 1904, p. 135.
- [7] HALSTED. "Vincent's Angina." *Laryngoscope*, xxii, 1912, p. 1377.
- [8] HARWOOD-YARRED and PANTON, P. N. *Lancet*, February 17, 1906.
- [9] PETERS. *Journ. Infect. Dis.*, 1911.
- [10] HULTGENS. *Journ. Amer. Med. Assoc.*, 1910, p. 857.
- [11] HEWLETT. "Manual of Bacteriology," sixth edition.
- [12] WEAVER and TUNNICLIFF, RUTH. *Journ. Infect. Dis.*, vol. ii, 1905.
- [13] ABEL. *Cent. f. Bakt.*, 1 Abt., Orig., Bd. xxiv, 1898.
- [14] BERNHEIM. *Ibid.*, 1 Abt., Orig., Bd. xxiii, 1898.
- [15] BEITZKE. *Ibid.*, Ref., Bd. xxxv, 1904.
- [16] ELLERMANN. *Ibid.*, 1 Abt., Orig., 1904, Bd. xxxvii, p. 729.
- [17] MUHLENS and HARTMANN. *Zeitschr. f. Hyg.*, 1906, p. 81.
- [18] VON BEUST, THEO. *Berl. klin. Wochenschr.*, November, 1909, p. 2058.
- [19] ELLERMANN. *Cent. f. Bakt.*, 1 Abt., Orig., 1905, Bd. xxxviii, p. 383.
- [20] BISSON. "Practical Bacteriology, Microbiology and Serum Therapy."
- [21] HESS. *Epitome, Brit. Med. Journ.*, January, 1904.
- [22] GERBER. *Deutsch. med. Wochenschr.*, 1910, Bd. xxxiv, p. 2385.
- [23] MUCH. *Med. klin.*, 1908, Bd. iv, p. 1119.
- [24] SAVERIO. *Arch. ital. di otol., rinol. et laryngol.*, 1910, vol. xxi, p. 177.
- [25] THOMSON, Sir STCLAIR. "Diseases of Nose and Throat," second edition, 1916, p. 415.
- [26] EHRLICH. *Münch. med. Wochenschr.*, 1910, Bd. lvii, p. 2268.
- [27] CITROL. *Berl. klin. Wochenschr.*, 1913, Bd. I, p. 627.
- [28] TAYLOR and MCKINSTRY. *Proc. Roy. Soc. Med.*, January, 1917.
- [29] OSLER. "Principles and Practice of Medicine," eighth edition, p. 381.
- [30] TUNNICLIFF, RUTH. *Journ. Infect. Dis.*, 1911, vol. viii, p. 321.
- [31] GOODRICH, HELEN P., and MOSELEY, M. *Journ. Roy. Microscop. Soc.*, January, 1917.
- [32] SOBERNHEIM. *Arch. f. Laryngol.*, 1909, Bd. xxi, p. 504.

NOTES ON A SERIES OF CASES OF GUNSHOT WOUNDS DURING THE CAMPAIGN IN EAST AFRICA.

BY MAJOR E. L. FYFFE.

*Royal Army Medical Corps,
Surgical Specialist No. 8 British General Hospital.*

AND

LIEUTENANT C. E. L. BURMAN.

Royal Army Medical Corps.

IN putting on record these cases of gunshot wounds occurring during the campaign in East Africa the authors do not lay claim to any particular originality, but do so with the object of illustrating the types, treatment and progress of wounds occurring in a country never previously fought over by white troops. It must be borne in mind that in such a country where the distances to be travelled from the fighting area to the base are very great, the methods of transport unavoidably slow owing to the rough nature of the country, and the opportunities for frequent dressings of wounds difficult, the conditions under which wounds are treated and their subsequent progress must of necessity be considerably different to those prevailing in more civilized countries such as Europe.

In none of the cases recorded were the wounds seen at the General Hospital, Nairobi, in less than three days from their infliction, and during this time the only dressing applied was the first field dressing. The reason for this delay in transport is that the only method of evacuation is by a single line (the Uganda Railway) which must of course deal primarily with the demands of the fighting area. Owing to the satisfactory condition of the wounded and of their wounds it was thought inadvisable on surgical grounds to change the dressings in the train except in a few cases, viz., shell wounds (not dealt with in this paper).

The type of country in which these wounds were received was that of dense bush, sparsely populated by man and beast, entirely uncultivated and of a malarial nature.

When considering the progress of the wounds, it is of interest to note that the wounded men in our cases had all been serving in tropical climates for several years and few had escaped malaria at one period or another. The bullets inflicting the wounds varied in calibre from 0.303 to 0.450, both rifle and machine-gun. The ranges also varied considerably from 700 yards to 15 feet.

The General Hospital, Nairobi, where treatment was carried out, is situated about 6,000 feet above the sea-level and in an equable and exceptionally healthy climate for a tropical country. We have found the method of case taking, below tabulated, invaluable in the cases of gunshot wounds admitted to our hospital.

- (1) Date of wound.....
- (2) Place where wounded.....
- (3) Position the man was in when wounded.....
- (4) Range at which wound was received.....
- (5) Variety of missile
- (6) The number of times dressed before reaching hospital
- (7) The date of admission to hospital.....
- (8) Entrance wound—
 - (1) Where: (a) Position
 - (b) Proximity to vital parts.....
 - (2) Size
 - (3) Character: (a) Shape
 - (b) Presence or absence of sepsis.....
- (9) Exit—
 - (1) Where: (a) Position
 - (b) Proximity to vital parts.....
 - (2) Size
 - (3) Character: (a) Shape.....
 - (b) Presence or absence of sepsis.....
 - (4) Relation to entrance wound.....
- (10) Pain: character—
 - (1) When: (a) Day
 - (b) Night
 - (2) Where.....
- (11) Position of bullet as shown by X-rays
- (12) Treatment—
 - (1) Operation: (a) Difficulties
 - (2) Movements.....
 - (3) Dressings
- (13) Mental aspect of patient

We have noticed in our series of cases that sepsis has been very slight and of a non-virulent type, in spite of the long distances travelled after receipt of injuries and the few dressings applied. The patients arrived in good condition and remained so during the whole of the treatment.

THE CHARACTER OF WOUNDS.

It is a generally recognized fact that wounds received at short ranges show an entrance and exit wound of a fairly uniform size unless marked resistance is encountered—such as bone.

Pte. A. R., wounded at 100 yards by rifle bullet 0·316 which entered the lower third of leg, passed through the muscles only, making an exit wound on the posterior side, showed a small entrance and exit of similar size; but in the case of Pte. C., of the ———, wounded at a range of fifteen feet by rifle bullet 0·303 there was a small entrance wound at the anterior surface upper third of the left trapezius and a large exit wound three inches by three inches in the region of the first and second dorsal spines (which had been struck). This is well shown in fig. 1 taken seventeen days after receipt of wound. This case also illustrates the fact that a bullet striking a bone obliquely produces a much larger exit wound than when it hits bone at a right angle.

The entrance wounds in all cases have been oval or circular and not larger than a threepenny piece, the edges have not been noticeably inverted

but more or less flush with the surface; sepsis, as before noted, was slight. The wounds have been mostly on the head, neck and extremities, i.e., the most exposed parts in bush fighting. Wounds of the abdomen are rare. It has been remarkable in our cases the extent to which main vessels have escaped injury, though nerves have frequently been involved.



FIG. 1.—Seventeen days after receiving wound.

POSITION WHEN WOUNDED.

We have found it very instructive to elicit from the patient the exact position he was in when struck and have noted the following points:—

- (1) If skin is tense, the bullet generally passes right through.
- (2) If skin is slack at time of receipt of injury, the bullet generally lodges.
- (3) Difference between exit and entrance wounds.

The cases cited below are examples of the above points.

Case 21.—Lance-Cpl. H. J., aged 25 years, Royal Fusiliers, was wounded at 300 yards range by a machine-gun bullet while in the act of firing. The bullet struck his right forearm, four inches below olecranon, on the upper surface, passing under the cellular tissue, lacerating the bicipital fascia, bursting open the skin in the fold of the elbow, passing onwards under the skin and making an exit in the middle of the upper arm on the inner side, pushing some of the biceps muscle with it.

Case 14.—Pte. E. L., Royal Fusiliers, was wounded at a range of 600 yards by a rifle bullet while lying on his back with his left extremity drawn up and his right crossing over it. Bullet entered at inner side of left thigh at junction of lower third with upper two-thirds (top of Hunter's

canal), passing downwards and outwards through the muscles, finally lodging just underneath tensor fasciæ femoris one inch lower down than level of entrance wound.

Case 33.—Pte. J. O., aged 24 years, Machine-gun Company, was wounded at 700 yards range by machine-gun fire while advancing—his body upright and his left leg being forward at the time he was struck. The bullet struck his right buttock making a gutter wound about four inches in length, passing onwards enucleating the left testicle and cord out of the left side of the scrotum, and then grooved the inner side of left thigh close up to the groin for about four inches in extent, in a similar manner as the wound in the right buttock. It was quite impossible to determine



FIG. 2.

which was the entrance and which was the exit wound, until he was questioned as to the position he was in when hit. The left testicle hanging lower than the right also helped in elucidating the direction. Other interesting points in this case were the absence of pain in the left testicle, with final atrophy of the testicle and withdrawal of remainder into scrotum by the dartos and cremasteric muscles without any surgical interference of a plastic nature (see fig. 2).

INJURY TO NERVES.

This had been the commonest complication in our series of cases. Temporary paralysis, peripheral neuritis and paresis have resulted in many cases from concussion effects to the nerves, hæmorrhage round a nerve with resultant pressure, and in one case direct lodgment of the casing of a bullet in the nerve itself. Absence of pain has often been found to be due

to division of cutaneous nerves, and in connexion with this we have noted one case where temporary paralysis (functional) was produced.

Pte. G. D., Machine-gun Company, was wounded by rifle bullet at 100 yards range. The bullet entered above left clavicle about the middle, making an exit above centre of spine of scapula. Fourteen days after discharge from the surgical section he was referred to us for further treatment, having developed complete paresis of the left arm. Careful examination was made, and no cause could be ascertained. The patient was told that the nerves were not damaged, and he made a rapid and complete recovery.

Case 28 (illustrating paresis from hæmorrhage around nerves).—Cpl. C. B., aged 30, Machine-gun Company, was wounded on March 11, 1916, while lying down facing the enemy. The bullet (rifle) entered just below the middle third of the left clavicle. No exit wound evident. X-ray photos, taken on several occasions, of the whole of chest and left arm failed to show bullet. There was, on admission March 14, 1916, some difficulty in raising the left arm, and severe pain—worse at night. On March 23, 1916, wrist-drop was noticed, also flabbiness of all forearm muscles. On March 24, 1916, a large ecchymosis appeared on the chest wall, and the biceps was paretic.

Recovery of a group of muscles was always preceded by severe pain. On May 16, 1916, patient could raise the arm above the head. From now onwards progress was steady towards complete recovery.

Case 18 (illustrating lodgment of bullet in nerve substance with recovery after removal).—Pte. J. M., aged 27, Loyal North Lancs., was struck on January 20, 1916, by a piece of casing, the result of an explosion of a belt of cartridges which was lying close to a fire. The wound was situated at the junction of the upper with the middle third of right arm. Complete anæsthesia of the little and ring fingers of right hand was noticed on January 21, 1916. The wound was explored under chloroform but no foreign body was found. Patient was admitted to General Hospital, Nairobi, on January 21, 1916; the same condition of anæsthesia was present, no wasting, only tingling. Pain was evident on pressure over the wound. X-ray photograph showed a small piece of metal above, and internal to, wound. Owing to peculiar anæsthesia (not anatomical), massage was ordered, also aspirin for the pain. Eight days after admission he was transferred to a convalescent home. On March 12, 1916, he was again transferred to the surgical section on account of persistent pain in the arm, with anæsthesia as before, and commencing contraction of the two fingers.

On examination, a tumour about the size of a small marble could be felt just above, and internal to, the healed wound in the upper arm; it was very painful on manipulation and corresponded with the position of the metal as seen in the X-ray photograph. Operation was undertaken on April 8, 1916. The mass when exposed was found to be median nerve

with fibrous tissue binding together the ulnar nerve. A small piece of metal casing was removed from the substance of inner side of the median nerve close to the mass of fibrous tissue between the median and ulna. Recovery after operation was rapid and complete, all pain disappearing within twenty-four hours.

Case 25 (illustrating peripheral neuritis).—Cpl. R. P., aged 31, Rhodesian Regiment, received a flesh wound on March 11, 1916, by rifle bullet at fifty yards range, about two inches long, raising a flap of skin and exposing the subcutaneous tissues in the region of the sciatic nerve at the lower fold of right buttock. On admission, he complained of numbness of foot and knee and inability to flex ankle. X-ray photograph was negative. Plantar reflex absent. Knee-jerk active. On April 15, 1916, he walked with difficulty, throwing his right leg forward jerkedly. Progress was slow, but he has since made a complete recovery.

MENTAL CONDITION OF PATIENT.

The knowledge by the patient of the presence of a lodged bullet often has a marked effect upon his progress. It is immaterial to the patient mentally whether the position of the bullet is one of danger or not. The fact that it is lodged produces aches and pains which disappear rapidly on extraction. This has influenced us in extracting bullets which we otherwise would have left alone. It has been noticed that, in cases where the bullet has passed clean through the tissue without injury to the bone or other structures, patients have developed mental phenomena producing well-defined deformity, such as torticollis and contractions around joints. Pain has been conspicuous by its absence, but in the rare cases where pain has been a marked feature in a case of lodged bullet, extraction has not caused such rapid relief as one would anticipate. This absence of pain, in our opinion, was probably due to the rarity of sepsis, excepting those cases where cutaneous nerves were divided.

VALUE OF X-RAY PHOTOGRAPHS.

We have adopted as a routine practice the X-raying of every case of gunshot wound admitted to hospital. Although in many cases entrance and exit wounds have been well defined and the wound apparently only a simple flesh wound, X-rays have revealed pieces of casing of bullets.

Case 1.—Pte. J. R., aged 24, Rhodesian Regiment, wounded on March 4, 1916, by rifle bullet at fifty yards range, received two separate wounds in the region of the elbow, one passing through the skin over the olecranon, the other through the skin in front. Entrance and exit wound were well marked in both wounds. Patient was discharged on March 28, 1916, as fit for duty. On April 3, 1916, he was re-admitted on account of weakness in the arm and pain over the olecranon. Examination revealed a cone-shaped fibrous tumour over the olecranon. Tumour was about one inch across the base—movable and not fixed to the skin. An X-ray

photograph showed a piece of metal casing embedded in tumour. Removal was followed by rapid recovery. The tumour was gritty on section, suggesting osteogenetic changes. Unfortunately, the piece removed for microscopical examination was lost.

INDEFINITE LOCALIZATION OF BULLET.

It has been found inadvisable to attempt extraction of bullets without previously having had them definitely localized in two planes. This is especially of importance in such places as the extremities where the flattening of the tissues due to lying on the plate at the time of photographing produces a wrong impression as to depth and relation to bone.

It is also of great importance to have the photograph taken immediately or as soon as possible before operation.

Case 13.—Pte. J. J., aged 23, Loyal North Lancs., was admitted on February 15, 1916, having received a wound on February 12, 1916, by rifle bullet at an unknown range. On examination there was a small oval wound just above the left anterior superior iliac spine, but no exit. He complained of slight pain in the groin, and on February 19, 1916, it had travelled down the left thigh, which was not swollen. X-ray examination negative. The patient was discharged to a convalescent home on February 27, 1916, and was re-admitted on March 16, 1916, on account of persistence of swelling of leg and thigh, and severe pain in Scarpa's triangle. Under rest and evaporating lotions this rapidly disappeared. On March 22, 1916, X-ray with localizer showed bullet lying over the anatomical position of the left iliac vein. The œdema and pain could now be accounted for. Per rectum a tender spot could be felt in the position of the bullet, as shown by X-rays. Abdominal laparotomy was performed on March 25, 1916, but nothing resembling a bullet could be seen or felt except by bimanual examination, when an occasional suggestion of a bullet could be located in the cellular tissue behind the rectum. As it was thought inadvisable to proceed further owing to difficulty of reaching the bullet through abdominal incision, the wound was closed. On April 9, 1916, the left leg again became swollen, and X-ray photograph showed the bullet apparently lying just above symphysis pubis. On April 22, 1916, a final X-ray (before transfer to Wynberg, Cape Town), showed the bullet lying exactly over hip-joint cavity, i.e., between the rim of the acetabulum and head of femur. This case demonstrates how a bullet may move somewhat rapidly from one place to another, even when the patient is confined to bed, owing to the laxity of tissues behind the peritoneum following the course of the left iliac vessels and psoas muscle. In some cases it has only been after several X-ray photographs that the presence of a lodged bullet has been demonstrated, and in others it has not been ascertained at all, in spite of there being no exit wound and evidence of a lodged bullet such as paresis, fracture and hæmorrhage. Where there

is no exit wound an area in close proximity to the entrance wound on either side should be examined by X-rays.

Case 8.—Serjt. J. P., aged 34, Rhodesian Regiment, received a wound on the outer side of the right leg about three inches below the knee, at 300 yards range by rifle bullet. There was no exit wound—X-ray showed a spiral fracture at the middle of tibia, but no bullet. Several subsequent photographs failed to show any trace of a foreign body.

EFFECTS OF LODGED BULLETS.

Besides the mental effects produced by the knowledge of a lodged bullet already described, definite physical effects have been observed, viz., œdema of the part below due to pressure on veins (vide *Case 13*), nerve symptoms already noted under the heading “Injuries to Nerves,” and mechanical interference with carrying and handling of equipment.

Case 21.—Pte. A. S., aged 22, Rhodesian Regiment, was wounded by a revolver bullet at forty yards range. Entrance wound above left clavicle, no exit wound. X-ray showed bullet lying in fourth interspace left side about one inch from spines of vertebræ. Any pressure applied over part caused slight pain. He returned to duty on April 4, 1916, but was re-admitted on April 3, 1916, owing to pain over the area when carrying his pack. Removal of the bullet was easily carried out under local anæsthetic.

INJURIES TO MAIN VESSELS.

This complication has been exceptionally rare, and aneurysm has only been noted in two cases (both left subclavian), but it is important to note that, in injuries to bones, the nutrient vessel may be torn, simulating hæmorrhage from a large vessel in the tissues. Examination of the condition of the main vessels below the seat of the wound should never be neglected.

Case 37.—Pte. A. M., aged 25, Rhodesian Regiment, was wounded on March 11, 1916, by an epiflading bullet at an unknown range. On admission, April 14, 1916, there was a linear wound, with a raised flap of skin just below the tubercle of the right tibia, from which quite a large amount of fresh hæmorrhage was occurring. The tibia was fractured. The main vessels at inner side of ankle were normal. There was no exit wound. Owing to the condition of the patient an X-ray photograph was not taken. Treatment was confined to arrest of hæmorrhage and fixation of the limb. Hæmorrhage occurred at irregular intervals until April 12, 1916, when it became rather severe—sufficient to cause a rise in pulse rate and some anæmia. The patient was anæsthetized on April 14, 1916, and three sequestræ were removed. The fractured tibia was noticed to be firm. After the removal of these fragments of bone the temperature of the patient became normal (a rise above 100° F. had never been noticed since admission), and no more hæmorrhage occurred. Swelling of the calf had

been noticed since commencement of hæmorrhage, and on April 24, 1916, the calf became tender, and a sero-sanguineous brownish fluid welled up through the entrance wound. An incision was made into the tissues of the calf but no pus was liberated. On May 3, 1916, the leg showed marked signs of bowing with a rise of temperature. An X-ray photograph was now taken which disclosed the bullet lying two inches below the fractured tibia in front and to inner side. The tibia was markedly comminuted and fibula also fractured. Extension was applied, and on May 23, 1916, the patient was chloroformed and the entrance wound opened up, a counter incision in the calf was made and the bullet extracted, at the same time freeing a large quantity of pus; a drainage tube was passed downwards from the site of the entrance wound and brought out through the counter opening in the calf. From now onwards the patient did well and has, since his transfer to Wynberg, had some more sequestra removed from the tibia. In this case the hæmorrhage was undoubtedly from the nutrient artery of the tibia. Operation was delayed on account of the likelihood of opening new planes to sepsis, and to allow Nature to commence bone formation, in the hope that his leg would be saved.

RESULTS AND METHODS OF TREATMENT.

The only methods of treatment adopted in this series of cases other than operations, have been :—

- (1) Continuous saline baths.
- (2) Fomentations.
- (3) Hydrogen peroxide.
- (4) Massage and movements.

Of these, preference has been given in all cases to the continuous saline treatment, supplemented as occasion demanded by (2) and (3). The whole affected part was immersed in saline at body temperature in a utensil of suitable shape. The saline could be drawn off by a tap and replaced at regular intervals. This treatment was commenced about 7 a.m., and continued throughout the day, and a dry gauze dressing applied at night, so that the tissues had a rest from continuous moisture and did not become sodden—interfering with the process of healing. This intermission of soaking we consider of great importance in the treatment of wounds by this method. The saline baths were continued until there was practically no discharge from the wound and the process of healing was well advanced. Throughout the process—movements of all joints around the affected part have been encouraged, in this way avoiding contracted and stiff joints.

The complete absence of stiff joints, unsightly contractions, adherent scars and deformities, have fully justified this method of treatment. In cases where this treatment was anatomically impossible, i.e., wounds of the face, fomentations were used, scarring and contraction resulting. Treatment has been continued by massage and movements, after cessation of the saline baths.

TREATMENT BY OPERATION.

Extraction of bullets has been done, in all cases where considered necessary, after definite localization by X-rays in two or more planes. In cases where the bullet was producing no effects—physical or mental—and its extraction would have caused damage to important structures not primarily interfered with, extraction was not attempted.

Drainage and curettage have not been found necessary in our cases owing to the small incidence of sepsis. The difficulties experienced in these extractions were primarily due to reliance on X-rays in one plane only, and to X-rays taken at too long a period before operation. A danger that we constantly bore in mind was that of opening up new planes of tissue to sepsis, when extraction could be carried out at a later date under more favourable conditions. A point of interest in connexion with operation is that, after administration of chloroform in a malarial patient an attack of fever invariably ensued within twenty-four hours. These attacks of malaria have in no way interfered with the healing process.

CONCLUSIONS.

The conclusions we have drawn from these cases are that:—

(1) Sepsis is slight and of low virulence in cases of wounds caused by rifle bullets in this country.

(2) Careful note-taking on all cases is of great value, on the lines indicated above.

(3) In all cases of rifle bullet wounds, nervous phenomena should be looked for, whether injury to a nerve is suspected or not.

(4) The main blood-vessel below the wounded part should be compared with the corresponding vessel on the opposite side of the body.

(5) The mental condition should be carefully followed throughout, and after treatment.

(6) All cases of rifle bullet wounds should be X-rayed in two planes whether the bullet is lodged or not, and immediately preceding operation; also if X-ray on one occasion fails to show the presence of a lodged bullet, two or more photographs should be taken before deciding the absence of a piece of metal.

(7) Early movements should be carried out in all cases to avoid contractions and deformities.

(8) Saline baths have been found the most efficacious treatment in all cases of rifle bullet wounds.

REMARKS ON THE TREATMENT OF INFECTED, ESPECIALLY WAR, WOUNDS.

By RUTHERFORD MORISON.

IN the first year of the War the accepted rules for its infected wounds were that they must be gaping open and frequently dressed—the same treatment as was adopted for such wounds a hundred years ago—and these threatened to become *the* leading principles of military surgery.

But it is always good to work for an ideal, and mine was to discover some method of cleansing and using antiseptics which would allow of immediate closure of the wound and infrequent dressings of it. I have succeeded beyond my most sanguine expectations, and though not claiming perfection for this method of wound treatment, I do not hesitate to claim that it is an enormous advance on any so far suggested.

It is now certain that if the entire cavity of an infected wound can be thoroughly cleaned mechanically, then treated with suitable antiseptics, satisfactorily closed with sutures, and suitably dressed, it will heal frequently under a single dressing, and in more chronic cases without serious disturbance. This has been proved by hundreds of cases in the Northumberland War Hospital, and in the practice of surgeons who have communicated their results to me. The latest convoys we have had from France show that our method is now widely known, as more than half of the patients bring a card with them stating that they have been bipped. If the difference between these cases and those treated by other methods could be seen by military surgeons, there would soon be no other means used until something better had been demonstrated.

Capt. Anderson, R.A.M.C., speaking at a medical conference at Malta, said: "By the general and systematic use of bipp the work of the Surgical Branch of the Royal Army Medical Corps could be reduced by at least two-thirds." In addition to this I entertain no doubt that lives and limbs have been saved which would have been lost by any other methods, that suffering has been averted, expense diminished, and recovery hastened by this one.

Objections have been noted, such as iodoform or bismuth poisoning, that bipp interferes with X-ray examination after its application, and that bacteriological proofs of its efficiency are lacking; but I am convinced that these objections, important though they may be, should not be allowed to weigh against clinical evidence so definitely in favour of this method in times of such urgency. A study of means to overcome them should be the chief consideration.

The greatest objection, to which my attention was specially directed by Surgeon-General Sir George H. Makins, and one which cannot be exag-

gerated, is the possible danger of gas gangrene from closing these freshly infected wounds at the Front. This problem requires careful handling for settlement, and must be left to the accomplished surgeons who direct surgical advance in the fighting zones.

The most painful and dangerous wounds in the past were those involving the knee-joint. Thanks to the excellent surgery done at the Front, I am able to record a series of cases to substantiate the statement that they now cause the patient and ourselves very little trouble or anxiety.

The following examples of results are from patients at present or recently in my wards at the Northumberland War Hospital:—

WOUNDS OF KNEE-JOINT.

Case 1.—Wound of Knee-joint by Shell: Removed from External Condyle of Femur.

A private, aged 31, was admitted to the Northumberland War Hospital on August 27, 1917.

History.—He was wounded in the left knee by a shell on August 7, 1917.

Note from France.—“Casualty Clearing Station, August 7, 1917: Penetrating gunshot wound of knee-joint—entered anteriorly, grooving outer border of patella and entering external condyle of femur, in which it lodged. Wound excised and joint opened up laterally by T-shaped incision. All loose bone scraped away thoroughly, and foreign body removed. (He brought with him the piece of shell, roughly half an inch square.) Bipp rubbed in. Synovial membrane stitched and Dakin-Carrel into subcrural pouch.

“South African General Hospital, August 9, 1917: Wound rebipped and quite clean.”

On admission to the Northumberland War Hospital, August 27, 1917: Left lower limb on a Thomas knee splint. On antero-external surface of left knee-joint an irregular wound, $3\frac{1}{2}$ inches by $2\frac{1}{2}$ inches; greater part superficial. At the lower end a deeper portion was packed with gauze. When this was removed, a little bipp came out of the depths. This wound appeared to be deep enough to go down to bone. In the upper part of the wound a Carrel-Dakin tube, which was removed. Wound clean. Some swelling round knee-joint, but no pain, and patient quite well. Rebipped.

X-ray Report.—August 30: “Gutter in external condyle of left femur, and another on the superior external border of the patella.”

After admission, patient's recovery was straightforward, without pain or other disturbance. November 1: Wound very small, but not quite healed. Splint left off. November 8: Almost healed. Movement in knee fairly good, though not encouraged yet.

08 *The Treatment of Infected, Especially War, Wounds*

Case 2.—Bomb Wound of Upper End of Tibia and Knee-joint and Popliteal Vein.

A driver, aged 30, admitted to the Northumberland War Hospital on October 3, 1917.

History.—Wounded on September 9, 1917, by an aeroplane bomb. (He had multiple wounds, but only that of the knee will be considered.)

Note from France.—"Canadian Casualty Clearing station, September 9, 1917: Left knee track of missile through head of tibia cleaned up and removed from posterior aspect of joint in popliteal space. Popliteal vein found to be wounded—tied and dressed. One Carrel tube in head of tibia. Bipp soft parts. Wound closed.

"African General Hospital, September 12, 1917: Since admission has been cleaned up; swelling at first below wound, but disappeared, and circulation good. Still fever at night."

On admission to Northumberland War Hospital, October 3, 1917: Left leg in Thomas knee splint. Over inner surface of left knee, and extending on to leg a curved incision wound, six inches long, healed at either end, but about the centre of it a superficial, granulating wound, about the size of a sixpence. Over the popliteal space an incision wound, six inches long, closed at either end, but gaping in the centre, showing a granulating, superficial area, $3\frac{1}{2}$ inches by $2\frac{1}{2}$ inches. The patient made a straightforward recovery. November 8: Wounds healed. Movement of knee-joint fair. Having massage.

Case 3.—Wound of Knee with Shrapnel Ball and Fracture of Patella: Excision of Ball from Knee.

A private, aged 19, admitted to Northumberland War Hospital October 17, 1917.

History.—Wounded on September 21, 1917, in the left knee by a shrapnel ball.

Note from France.—"Stationary hospital, September 21, 1917: Wound of entry over left patella a little to right of its centre. Joint swollen and painful. Pulse 90; temperature 99° F. *X-ray Report.*—September 22: 'Shrapnel ball anterior to internal condyle. No bone lesion.' Chloroform and ether. Ball removed; joint was full of blood, synovial cavity having been traversed with *partial fracture of patella*. Joint washed out with saline, and bipp, $\frac{1}{2}$ ounce, inserted; stitched up without drain. October 9: Fit to leave."

On admission to Northumberland War Hospital, October 17, 1917: Left leg in metal splint. On anterior surface of left knee-joint an irregular, apparently superficial, clean, granulating wound, two inches by one inch. On inner surface of knee, and extending on to the thigh and leg, a curved healed incision wound, six inches long. Slight swelling of knee. No pain nor constitutional disturbance.

X-ray Report (same day) : "There is a vertical fracture of the patella. A few loose fragments are seen about its superior margin, but there is no displacement of main fragments."

November 1 : Almost healed. A little movement in joint.

Case 4.—Shrapnel Wound of Knee-joint, with Fracture of Internal Tuberosity of Tibia.

A serjeant, aged 22, admitted to Northumberland War Hospital on August 22, 1917.

History.—Wounded on August 13, 1917, by shrapnel. (He had multiple wounds, but that of the knee only will be described.)

Note from France.—"Casualty Clearing Station, August 13, 1917: Left knee-joint: Compound fracture inner edge tibial plateau internal lateral extension of synovia and knee-joint proper ruptured. Knee-joint irrigated with salt and alcohol. Capsule repaired and closed with one thickness of bipp inside. Fracture cleaned, treated with carbolic, alcohol and bipp and ligamentous capsule closed over it."

On admission to Northumberland War Hospital, August 22, 1917: The left leg was in a Thomas knee splint. On anterior surface of left knee-joint was a gourd-shaped wound, $4\frac{1}{2}$ by $1\frac{1}{2}$ inches, apparently superficial, with a little bipp on its surface. The knee-joint was swollen and contained some fluid. Patient well. No pain. Rebipped.

X-ray report (same day).—"Inner tuberosity of tibia hidden by bipp. No fracture seen elsewhere."

Recovery from all wounds (which also had been bipped) straightforward. October 16 : Convalescent. Flexion of knee to a right angle.

Case 5.—Rifle Bullet Wound of Knee-joint: Fracture of Upper End of Tibia.

A private, aged 19, admitted to Northumberland War Hospital November 10, 1917.

History.—Wounded in the left knee on November 3, 1917, by a sniper's bullet (range about forty yards).

Note from France.—"Canadian Casualty Clearing Station, November 4, 1917: Through-and-through wound below joint. Compound fracture of tibia. Hæmorrhagic effusion in joint. Joint aspirated. Glycerine formalin two per cent ten cubic centimetres injected. Wounds excised. Track cleaned and bipped. Very little comminution. Hæmorrhage arrested. Wounds closed.

"General Hospital, November 5, 1917: Glove drain removed."

On admission to Northumberland War Hospital, November 10, 1917: Left leg in metal splint. On outer surface of left leg just below knee-joint a vertical incision wound four inches long, closed at either end with silk-worm gut sutures. Wound edges not in perfect apposition. Clean. On

310 *The Treatment of Infected, especially War, Wounds*

antero-internal surface, at same level, a vertical incision wound; $2\frac{1}{2}$ inches long, entirely closed by sutures. There is considerable swelling of, and some fluid in joint but no pain or constitutional disturbance.

X-ray Report.—November 13, 1917: "Gutter in tibia at level of head of fibula. No fracture through the bone."

November 28.—Inner wound healed, outer wound almost healed. Sutures removed. To have daily spirit dressing.

FRACTURES.

Next to the knee-joint, fractures have been the worst lesions to treat. Such frequent dressings as were necessary from profuse suppuration and the painful movements necessitated, have developed a great output of skilfully devised splints in the endeavour to overcome some of these difficulties. None of them were wholly satisfactory. We are now able so to modify the infection as to leave fractures undressed for weeks, and have returned to the use of very simple splints. Syme is reported to have said that fractures required only a skilful and careful surgeon, Gooch splinting and a penknife for their treatment, and this is as true as most aphorisms are.

Case 1.—Fracture of Both Bones of Forearm in Upper Third.

A private, aged 49, admitted to the Northumberland War Hospital on October 3, 1917.

History.—Wounded on September 20, 1917, by a bullet in the left forearm.

Note from France.—"Casualty Clearing Station, September 21, 1917: Operation, 8 p.m. Wound opened up. Both radius and ulna of left arm broken. Through-and-through track. Small fragment of bone removed. Wound bipped. Splint and dressing applied.

"South African General Hospital, September 23, 1917: Wound dressed bipp. September 29: No temperature since admission. Arm was swollen, now better."

On admission to Northumberland War Hospital; October 3, 1917: Over radial border of left forearm just below elbow-joint a large, clean, apparently superficial wound, three inches by two inches, with bipp on its surface. Over ulna border, slightly lower level, another similar wound, about same size but deeper and packed with bipped gauze, but also clean. (Packing removed.) Obvious fracture of both bones in bad position. Loss of sensation in median distribution. Radial pulse normal.

X-ray report.—"Radius and ulna comminuted fracture with inward and backward displacement. The foreign bodies at the wrist are (I believe) all in splint."

Operation.—October 10, 1917: Wounds explored and bipped. Arm put up in good position with forearm fully supinated, in two Gooch splints reaching from the elbow to the finger tips. The anterior splint was turned with wooden convex surface down, to avoid circular compression

of the bones. Supination of the forearm was maintained by an angular aluminium splint (Treves) extending from the shoulder along the back of the arm to the hand. November 3: Dressed for first time (one month after operation). Dressing almost dry. A small piece of shell was picked out of a little hole in the ulnar wound. The radial wound was apparently superficial: some bipp in the middle of it. Arm of good shape and firm bony union. Rebipped and put on metal splint only.

Bacteriological Report on Smear from Dressing. — "*Staphylococcus aureus*." November 8: Sent convalescent.

*Case 2.—Fracture of Both Bones of Forearm with much Displacement.
Fracture plated.*

A private, aged 25, admitted to Northumberland War Hospital, August 26, 1917.

History.—Wounded on July 31, 1917, by a shell.

Note from France.—"Casualty Clearing Station, July 31, 1917: Compound fracture radius and ulna right forearm, bipped. South African General Hospital, August 1, 1917: Considerable swelling upper arm and of hand. August 11: Dressed under general anæsthetic; put up in Jones abduction caliper splint. Bipp changed. August 24: Dressed. Light gauze pack with bipp. Wounds clean. Little pus. Rectangular splint."

On admission to Northumberland War Hospital, August 26, 1917. Bowing shortening and much deformity of right forearm. Over extensor surface of right forearm at its upper third, and extending on to ulnar border, an elliptical incision wound, clean and deep, packed with bipped gauze. Packing removed, and the lower fractured end of the bare ulna could be seen protruding from the lower end of the wound. Good deal of swelling round elbow. Arm on angular splint. No nerve nor vascular injury. Rebipped.

X-ray Report (August 26, 1917).—"Fracture of both bones $1\frac{1}{2}$ inches below elbow. Ends of ulna are in apposition but at an angle with convexity backwards. Radius lower fragment displaced far backwards with shortening."

Bacteriological Report. — "*Staphylococcus aureus* and Gram-positive bacillus. Fine and short, also club-shaped thick Gram-positive bacillus. Gram-negative bacilli and *B. coli*."

Operation.—August 31, 1917: No reposition of displacement could be effected by manual efforts. Wound enlarged down back of ulna, and the whole rebipped. The ulna was wrenched into good position with two Lane forceps, and retained there by a Lane plate with three screws at each end. The prickler, the plate and the screws were all smeared with bipp. The gaping wound was drawn together as far as possible by thick sterilized silk sutures, smeared with bipp. This covered and hid the plate but there was a granulating gap, one inch wide at the upper end where skin was lacking. The forearm, fully supinated, was supported by two Gooch splints,

312 *The Treatment of Infected, especially War, Wounds*

the anterior with the wooden side next the forearm, and the whole was fixed by an aluminium (Treves) splint reaching down the back of the arm to the hand. Anti-tetanic serum 500 units. September 7: The patient has had no trouble nor constitutional disturbance and was up and around the ward three days after operation. Anti-tetanic serum 500 units. October 13: Wound dressed for first time (six weeks). Some caked blood on dressing, almost dry. The wound was closed except for a small superficial, granulating area at the centre. The silk sutures were sticking out like stumps of trees in a burned dry forest, and were removed. Granulating area rebipped.

Bacteriological Report of Smear from Dressing.—"Staphylococci and streptococci."

October 18: Splints removed. November 1: Almost healed; massage. November 21: Healed, arm of good shape; function quickly returning.

Note.—I expected to have to remove this plate at the first dressing and do not know what may be required later. Meanwhile it is causing no trouble and is left alone.

Case 3.—Fracture of Skull. Fracture of Radius. Wound of Right Thigh.

A private, aged 33, admitted to the Northumberland War Hospital. September 27, 1917.

History.—Wounded on September 16, 1917, by shrapnel.

Note from France.—"Casualty Clearing Station, September 17, 1917. Gunshot wound head, fracture of outer table. Small button of skull removed for investigation. Inner table negative. Gunshot wound left wrist. Compound fracture of radius. All wounds excised. Bipp.

"X-ray Report.—Comminuted fracture of lower end of radius—with bipp.

"General Hospital, September 19: (1) Head wound had been stitched; a little pus at anterior end. (2) Looks fair; plug in. (3) Looks fair; plug taken out. September 21: Scalp wound; no more pus. Slight headache. (2) Plug removed from back of wrist—fracture of radius runs into wrist-joint. (3) Thigh wound healthy."

On admission to Northumberland Hospital, September 27, 1917: Over dorsal surface of left wrist-joint an irregular oval deep granulating wound, 2 inches by 2½ inches, showing bipp. Over radial border of left forearm, 1½ inches above wrist, a small granulating wound. Deformity of wrist like a bad Colles. (Details of other wounds omitted.)

X-ray Report.—"Fracture of radius just above wrist-joint with forward displacement of lower fragment and numerous small foreign bodies. Backward dislocation of arm at wrist."

Operation.—October 3, 1917: Fracture reduced—good position. Wounds rebipped. One thick silk bipped suture in dorsal wound; anterior and posterior Gooch splints. October 27: Dressed for first time since operation (twenty-four days). Dressing almost dry. Wounds healed but for super-

ficial, granulating area, size of a split pea. Arm in good shape and bone firm. Splints removed. To have daily spirit dressing.

Bacteriological Report of Smear from Dressing.—"Staphylococci and streptococci."

November 12.—Sent convalescent. Having massage. Not quite healed.

Case 4.—Gunshot Wound Left Humerus, Left Thigh and Left Foot.

A serjeant, aged 24, admitted to Northumberland War Hospital, October 3, 1917.

History.—Wounded September 23, 1917, by a shell.

Note from France.—"Casualty Clearing Station, September 23, 1917: Wound of left arm excised. Foreign body removed. Brachial artery and veins tied. Oblique fracture of humerus near middle. Bipp. Part suture. Paraffin pack. *Left thigh*: Foreign body removed. Bipp. Suture. *Foot*: Incised. Suture. African General Hospital, September 28: Wound of dorsum of left toe satisfactory. Wound of lower part of left thigh, no pain nor tenderness. Wound of left arm, H-shaped incision and a good deal of oozing. Arm slightly tense. Pulse 94; temperature 98.6° F."

On admission to Northumberland War Hospital, October 3, 1917: *Left arm*: A large H-shaped incision on left upper arm on inner anterior and posterior surfaces—anterior, vertical and transverse limbs of H, each about 3½ inches long, were closed with sutures. The posterior vertical limb, about same length, was gaping, but clean. No radial pulse on left side. Could move and feel fingers but complained of "pins and needles" in them. The arm was on a Jones arm splint. (Details of other wounds omitted.)

X-ray Report.—"Position of fracture obscured by bipp."

Operation.—October 6, 1917: Granulating wound posteriorly rebipped. Sutures removed from healed portion of wound. Splint removed, fracture reduced. Thick cottonwool pad, powdered with boracic acid laid on chest wall and into axilla. Arm bandaged firmly to side. No splints. November 3: Arm dressed for first time (four weeks). Splinted lightly for support. Very little discharge on dressing. Arm of good shape and bone united. All wound healed except a granulating area posteriorly 1 inch by ½ inch, and apparently superficial. Arm released, to be carried in sling. November 18: Arm dressed (second time, fifteen days after previous dressing). Some dermatitis. Pressure sore from splint at bend of elbow. Wound almost healed. To have daily spirit dressing. November 25 Arm much improved. November 28: Sent convalescent.

Case 5.—Fracture of Radius: Ulna grooved.

A private, aged 19, admitted to Northumberland War Hospital, October 17, 1917.

History.—Wounded on October 9, 1917, by machine-gun bullet.

Note from France.—"Casualty Clearing Station, October 9, 1917: Through-and-through wound of left wrist. Radius fractured. Ulna grooved in front. Wounds enlarged, cleaned and bipped. General Hospital: No interference, progress satisfactory."

On admission to Northumberland War Hospital, October 17, 1917: Over the middle of the radial border of the left forearm was an elliptical, clean wound, two inches by one inch. Over ulnar border, at same level, was a similar wound. No nerve or artery injury.

X-ray Report.—"Fracture of radius only, three inches to four inches above wrist. Some backward displacement of lower fragment. Two small detached pieces, possibly sequestra."

Operation.—October 20, 1917: Bone displacement reduced. Wounds rebipped and closed by thick silk sutures rubbed with bipp. Arm fixed with two Gooch splints. November 10: Dressed for first time (three weeks). Dressing quite dry. Wounds healed. Sutures removed. Arm of good shape. Union of bone not quite firm.

WOUNDS OF LEGS.

Case 1.—Sterile after First Dressing.

A private, aged 19, admitted to Northumberland War Hospital on October 3, 1917, with shell wounds of both legs.

History.—Wounded on September 20, 1917, by a shell.

Note from France.—"American Casualty Clearing Station, September 20, 1917: Penetrating wound left calf excised. Bipp. Foreign body not looked for, probably shrapnel. Large traversing wound right calf. Track excised. Bipp paste and eusol. South African General Hospital: September 21, 1917: Bipp dressing. Foreign body not removed from left leg."

On admission to Northumberland War Hospital, October 3, 1917: On posterior and internal surfaces right calf, about centre, an oval clean wound exposing muscle, $4\frac{1}{2}$ inches by $2\frac{1}{2}$ inches, showing bipp. No nerve nor blood-vessel damage. Rebipped. *Left leg*: on posterior surface of calf, a little above centre, an irregular clean wound, $1\frac{1}{2}$ inches by $\frac{3}{4}$ inch, showing bipp. Rebipped. *Face*: Small healed wound left cheek. Flame-shaped hæmorrhage outer quadrant left eye.

Operation.—October 6, 1917: Wounds curetted, rubbed with dry gauze, mopped with spirit, dried and bipped. Sutured with interrupted thick bipped silk mattress tension sutures with india-rubber tube and interrupted thick bipped silk sutures for edges. October 17 (eleven days later): Wound dressed for first time. Dressings dry, sutures all in position.

Bacteriological Report of Smears.—"No growth."

October 27: Dressed for second time. Wounds healed except at the upper end where one rubber tube had cut in on the right side. November 8: Sent convalescent.

Case 2.—Gunshot Fracture of Fibula.

A private, aged 36, admitted to Northumberland War Hospital on October 3, 1917.

History.—Wounded September 27, 1917, by a shell.

Note from France.—"Australian Casualty Clearing Station, September 29, 1917: Large wound on outer side of calf. No foreign body present. Bipp and excision."

General Hospital.—September 28, 1917: Wound redressed. Quite clean.

X-ray Report.—"Fibula fractured three inches down shaft—alignment perfect. One foreign body lies external and posterior to fibula."

On admission to Northumberland War Hospital, October 3, 1917: Over outer surface of left leg in upper half a large elliptical, deep, clean wound, $5\frac{1}{2}$ inches by $2\frac{1}{2}$ inches, exposing the divided peronei muscles, and through the gap the extensor muscles. Bipp on surface. No nerve nor vessel damage.

Operation.—October 6, 1917: Wound cleaned and bipped. Muscles sutured with thick catgut mattress sutures. Wound closed as far as possible by interrupted thick tension mattress sutures over drainage tubes and interrupted thick silk sutures for edges. Leg put up in two lateral Gooch splints. October 17 (eleven days later): Wound dressed for first time. Very little discharge on dressing. Wound not healed and surface covered with coagulated blood.

Bacteriological Report of Smear.—"Staphylococcus aureus and streptococcus."

October 27 (ten days later): Second dressing. Little discharge on dressing. Bipp sticking on small granulating surface in centre where wound could not be closed. Sutures removed.

Bacteriological Report.—"No growth."

November 8.—Sent convalescent.

Case 3.

The following case, though not military, conveys such useful surgical lessons that it is included. It proves the value of a knowledge of first aid, the importance of promptitude and efficiency in a country doctor, and illustrates an important point in blood-vessel surgery.

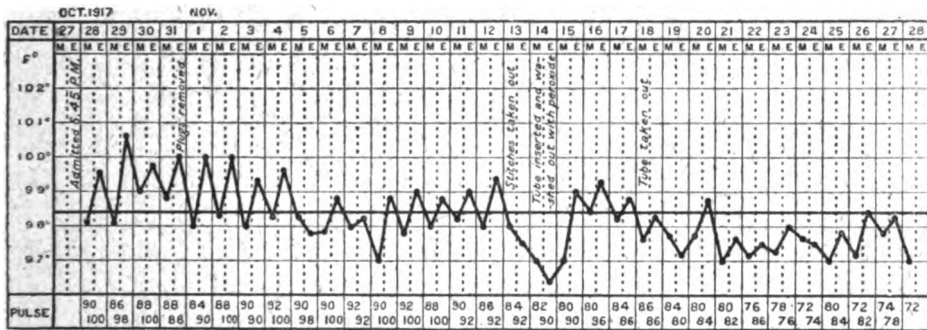
History.—Mr. A., aged 29, was out shooting with his brother on the afternoon of Saturday, October 27, 1917. He gave his gun to a boy to hold while he crossed a stream six feet wide. In handing the gun back the boy presented it muzzle first, and accidentally touching the trigger caused it to discharge. Mr. A. realized what was happening and in order to clear his body jumped up, and received the charge in his left thigh.

Instantly there was profuse hæmorrhage and he fell. The day was wet and cold, but fortunately he was wearing a waterproof coat. His brother, who had a good ambulance training, at once ripped open his breeches at the top and controlled his femoral artery by pressure in the groin. He kept up this pressure until Dr. Brookfield Fox arrived, thirty-five minutes later. The time of the shot firing was accurately established, because Mr. A.'s watch had stopped at 2.17. The doctor who saw at once that serious damage had been done to large blood-vessels, plugged the wound

cavity firmly with sterile gauze which he had brought, applied a tight bandage and having sent for the ambulance started an hour and a half later to bring the patient into a private hospital. Meanwhile the patient, in spite of such wraps as could be found, had got very cold lying on the ground. As soon as he started the doctor sent a telephone message to the hospital stating the nature of the case and asking that everything should be ready for operation. The patient arrived at 7 o'clock and was taken straight to the operating theatre. On admission he was fully clothed, pallid cold and sweating but conscious, and with a radial pulse easily felt. He was anaesthetized at once, undressed, and the wound was examined. On the anterior and inner side of the thigh over the line of the femoral artery, commencing about four inches below Poupart's ligament, there was a lacerated wound about four inches long, extending towards the inner part of the thigh. Some bleeding was still going on through the bandage and plug, but not actively. The femoral artery was compressed and the bandage and plug were removed. The wound was covered by a compress wrung out of 1—20 carbolic lotion and the skin of the thigh was cleansed with the same. There was a great spurt of blood as soon as pressure on the femoral artery was relaxed. The wound was extended to about eight inches long above and internally, so as to allow of free access, and the femoral artery was then seen, bare all round and running like a thick cord down the thigh. There was an opening in it about the size of a split pea at the junction of the upper with the middle third of the bared portion of vessel. A catgut ligature was tied above and below the opening and the pressure on the artery was relaxed. Between the two ligatures and close to the opening free hæmorrhage followed. It was then found that *a large muscular branch was given off close to the opening in the main trunk*. Ligature of this vessel and division of the femoral artery between the ligatures arrested all serious bleeding, but many vessels in the torn muscles oozed and in the depths of the wound a large branch of the profunda bled and was tied. There was no vein discoverable, and it seemed probable that the femoral vein had been completely destroyed. The sartorius and adductor muscles were torn through and much lacerated. Further examination showed that the main trunk of the profunda femoris was intact and that the charge lay almost under the skin on the outer side of the thigh, and was felt by my hand introduced through the inner wound. A large opening was made on the outer side of the thigh over the charge, from which a quantity of clothing, wads and pellets of No. 6 shot was removed. During the operation normal saline (1 dram of salt to 1 pint of water) temperature 100° F. when entering the vein, was given, but the radial pulse disappeared to reappear again later—when 3 pints had been introduced. Both wounds were cleansed as far as possible with the fingers, then scrubbed out with a long strip of sterile gauze pulled to and fro, then by a similar strip of gauze soaked in spirit used in the same way, and finally by a gauze strip covered with bipp, which was scrubbed into the wound surfaces by pulling the

strip from one side to the other. Slow oozing still continued from the lacerated muscles, and to stop this a gauze plug smeared with bipp was packed into each wound. Except where these protruded both wounds were closed by thick, deep, interrupted sutures of silk, soaked in tincture of iodine. The wounds were dressed with sterile gauze and abundant cotton-wool, 500 units of anti-tetanic serum was injected into the chest wall, the patient was put into a warm bed and an enema of one pint of coffee with a tablespoonful of sugar was administered.

After-progress.—Next day the patient had entirely recovered from shock and complained only of pain in his leg. The circulation in it was good, but there was obviously serious damage to the sciatic nerve. Four days later the dressing was removed for the first time and the plugs were taken out. The wounds looked free from any redness or swelling, but the patient's temperature (see chart) indicated a mild infection. Two days



later pus escaped from the inner and anterior wound, and about half an ounce could be squeezed out. Daily dressing was ordered, and suppuration from the inner wound in gradually diminished quantity continued until November 28, when only a small granulating area was left unhealed. Fourteen days after the injury the silk sutures used to close the wounds were removed. They had caused no irritation, and the sutured portion of both wounds healed per primam. He still has some pain, numbness and lack of power in the leg, but it is improving so rapidly that his complete recovery is almost certain.

This case allows me to draw attention again to the importance of an observation I made early in the War and which I published in the *British Journal of Surgery* (No. 10, 1915), and also in my "Contributions to Surgery," p. 491, as an illustrated article.

The point made was that "*The escape of an artery from a bullet is due to its elasticity and mobility. At points where branches arise the artery is tethered by them so that it becomes fixed and is pierced by the impact of the bullet, and the branches are either torn through or caught and divided.*"

I have never seen a more clear demonstration than this case offered,

but our experience of aneurysm and secondary hæmorrhage from damaged vessels fully confirms it.

A second point concerns the treatment I adopted in this case. Was it the best that could be done? I believe not, because though the result has been all that could be desired, we ran risks from prolonging the operation, and did not entirely succeed in preventing wound infection, because the wound treatment could not be made thorough enough. With this experience, and in a similar case, after opening and cleansing and giving ordinary surgical attention to the wounds I would now fill them up with A. E. Morison's magnesium sulphate cream¹ and dress them, leaving the dressing untouched for four days. Then I would bipp them and sew them up.

It is with great diffidence that I venture to suggest this as the most suitable scheme for military injuries which I have only had to treat in the later stages.

In any case, in these serious wounds with shocked patients, some readily applied first dressing, if it has been proved effective, should take precedence of more elaborate schemes. The report in the *Lancet* of November 3 by Captains L. Colledge and Hamilton Drummond and Lieutenant R. Worthington, on proflavine, and suggesting it as a first dressing, also appeals to me.

The advantages of such a first dressing, apart from its ease and the short time required to apply it, are that the objections to my method of treatment would no longer have importance. The most serious of these, because it is true, is that both iodoform and bismuth interfere with satisfactory X-ray examination. The X-ray examination could be fully made before their application if the method I have suggested were employed.

The second objection is that poisoning may follow as a result of bipp treatment. In the early days when wounds were filled with bipp, a few cases occurred, showing absorption. There have been no deaths from this cause in the Northumberland War Hospital, and for the last year no case in my wards has shown any sign (except a blue line round the necks of teeth, especially dirty ones) of this trouble. It may be that absorption occurs more readily from fresh wounds than from those of a few days' duration, though I have seen no evidence of this, or it may be that too much bipp has been left in the wound, or what appears to be a likely explanation is that bipp improperly made up has been used. We have had several samples obviously defective. When it is properly prepared and rubbed in a thin smear sticks to every portion of tissue so treated.

¹ Method of Preparation of the Magnesium Sulphate Cream.—One to five pounds of mag. sulph. *exsiccatum* are mixed with eleven ounces of glycerine acid carbolic (1–10). The dried mag. sulph. is in the form of a fine white powder which contains twelve per cent less water than ordinary mag. sulph. The glycerine acid carbolic is put in a *hot* mortar and the mag. sulph. added slowly, stirring and mixing with a warm pestle all the time. The result is a thick white cream, so hygroscopic that if exposed to the air it rapidly absorbs moisture and becomes fluid. To preserve it in a jar is essential.

SUMMARY OF TECHNIQUE.

(1) Under an anæsthetic, usually open ether, cover the wound with gauze wrung out of 1—20 carbolic acid, and clean the skin and the surrounding area with the same lotion.

(2) Open the wound freely and, if possible, sufficiently to permit of inspection of its cavity. A guide—a finger is the best if the size of the wound permits of it, and if not a thick probe—should be introduced to the bottom of the wound and held there and fully exposed. In doing this special regard must be paid to nerve trunks and muscular branches of nerves, since the division of blood-vessels, excepting the largest, and of muscles themselves does little harm as compared with that of the disability following nerve damage. Cleanse the cavity with dry sterile gauze mops, Volkmann's spoon, etc., and remove all foreign bodies.

(3) Mop the surrounding skin and the wound cavity with methylated spirit and dry it.

(4) Fill up the whole wound with bipp, rub it well in with dry gauze. Then remove all excess, leaving only a thin smear covering over the wounded surface. Dress the wound with sterile gauze and cover all with an absorbent pad. This dressing requires no change for days or weeks if the patient is free from pain or constitutional disturbance. Should, however, discharge come through, the stained part must be soaked in spirit and a gauze dressing wrung out of the same applied as a further covering.

Redressing is very simply done. After removal of the old dressings the wound is covered with a dossil of wool soaked in spirit, and the sticky, dirty-looking discharge is wiped off the surrounding skin until it is clean.

I am indebted to Colonel Adams for leave to publish the military cases.

A STUDY OF 109 CASES OF TRENCH FEVER, WITH SPECIAL REFERENCE TO THE CONDITION OF THE HEART.

BY MAJOR T. J. CREAN, V.C., D.S.O.

Royal Army Medical Corps.

AND

CAPTAIN B. H. BARTON.

Royal Army Medical Corps.

In a paper entitled "Trench Fever," appearing in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for April, 1916, Captain McNee, Lieutenant Renshaw, and Captain Brunt describe an illness affecting officers and men of the British Expeditionary Force in Flanders. The following notes are the outcome of a study of cases of fever with similar symptoms admitted to a divisional rest camp in France. This division was in Flanders from the early summer of 1915 until February, 1916, when it moved into the area it at present occupies in France. Cases of this nature were common in the division last summer and autumn, but undoubtedly became much more common in April and May of this year.

DISTRIBUTION OF CASES.

The authors quoted above state that their cases came from only two classes of men, those in or near the trenches and men of the Royal Army Medical Corps. This series shows a similar distribution thus:—

One infantry brigade provided	..	..	16 cases*
Another infantry brigade provided	..	..	30 ..
Another infantry brigade provided	..	..	40 ..
The pioneer battalion provided	..	..	3 ..
The Royal Army Medical Corps provided	..	..	9 ..
The Royal Engineers (Divisional Signals) provided	..	..	1 case
The Royal Field Artillery provided	..	..	9 cases, including one from the D.A.C. and one from the B.A.C.
The Royal Garrison Artillery provided	..	..	1 case

* This brigade was detached from the division for a time.

In this unit fourteen of the twenty-four N.C.O.s and men engaged in nursing contracted the disease.

TYPES OF FEVER.

There appear to be two distinct types of fever: (1) The remittent type with fever of the remittent or intermittent character, lasting from 5 or 6 days to 3 weeks or more (see Chart I).

(2) The relapsing type or "long" type of the authors previously quoted, with fever for 24 to 72 hours, followed by 3 to 6 days' apyrexia, with abatement of symptoms, then a relapse for 24 to 72 hours, then 3 to 6 days' apyrexia, and so on. A very common time for the relapse was on the fifth

day, from the acme of the preceding bout of fever; some cases relapsed every fifth day, others every seventh day, and so on, but seldom absolutely regularly (see Charts II and III).

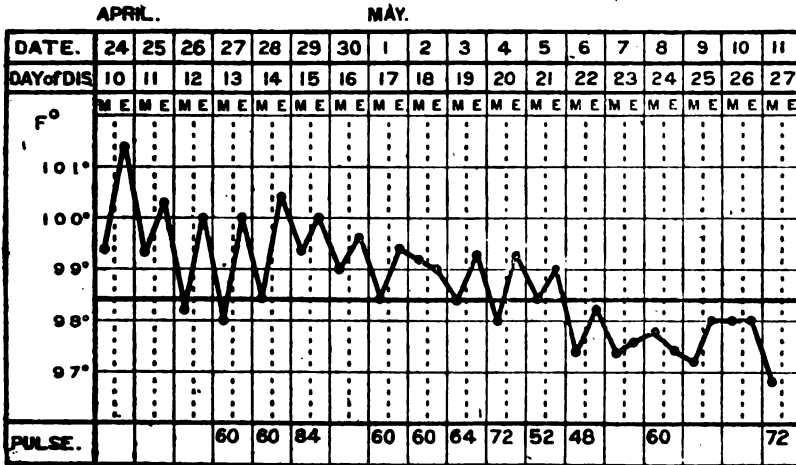


CHART I.

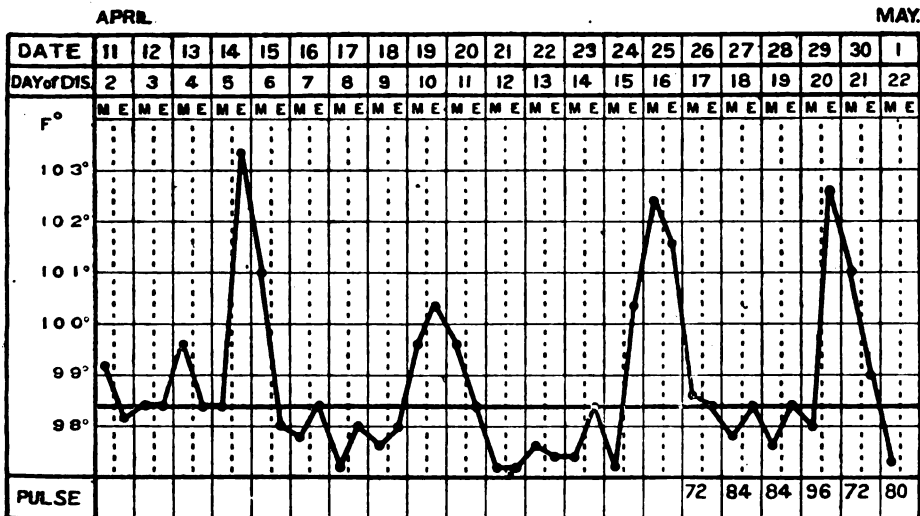


CHART II.

There were many cases that we could not definitely place in either group, as they resembled both, so they are put into a third "indeterminate" group (see Chart IV). Some of these were very interesting, the charts being just like those of Type 2 for ten to fourteen days, but after the second or third relapse they became like those of Type 1 (see Chart V).

Symptoms.—The onset is as a rule sudden with headache, usually

frontal, dizziness, and weakness of the legs, so that the man falls down; there is severe pain in the legs, usually the shins, sometimes in the thighs also, and very commonly in the back; belly-ache is also a common complaint. All the pains are very much worse at night, often coming on regularly at 5 or 6 o'clock every evening. Constipation is almost constantly present; we saw no case of diarrhoea. A slight cough is common.

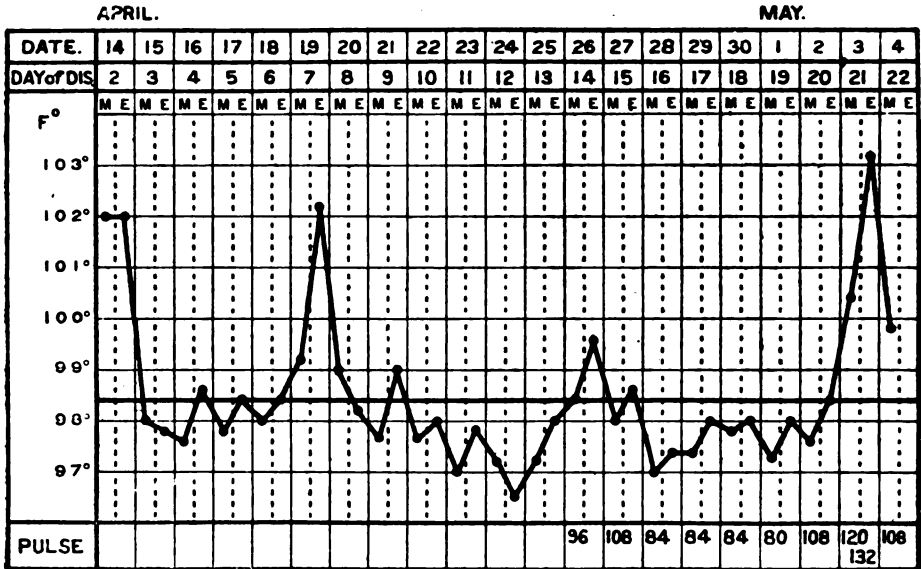


CHART III.

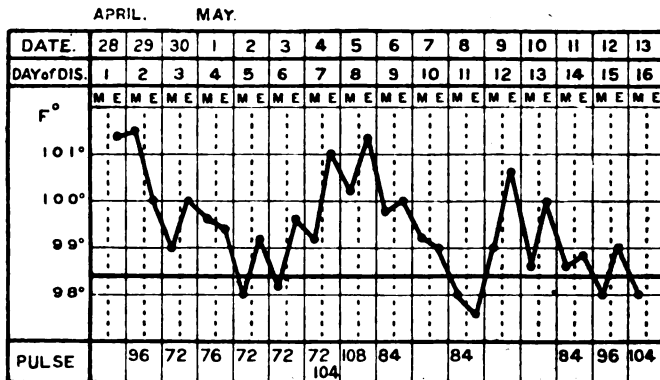


CHART IV.

Physical Signs.—The pulse is full and bounding, the rate about 90 to 108; in those cases in which the myocardium is affected it may be of low tension and a rate of 144 or more. The temperature is usually high, running up to 103° or 104° F. The respirations are quiet and not unduly increased in frequency.

Herpes about the lips and face was noted in several cases. The face, flushed at first, may become markedly drawn after a week's illness from pain and consequent lack of sleep. The tongue is dry, with a yellow-brown fur, which clears in a few days, commencing at the edges, leaving a perfectly clean, moist tongue without noticeable enlargement of the papillæ. The fauces are often congested, but patients do not often complain of sore throat. The lungs as a rule are quite natural, but occasionally there is slight bronchitis.

The heart is quite normal in cases seen on the first day, but the myocardium is very commonly affected after a week's illness, there being sometimes definite dilatation, or more commonly a muffling of the first sound at the apex or a very loud first sound with or without a "slapping" impulse; a systolic murmur at the apex developed in two cases, but in

MAY.

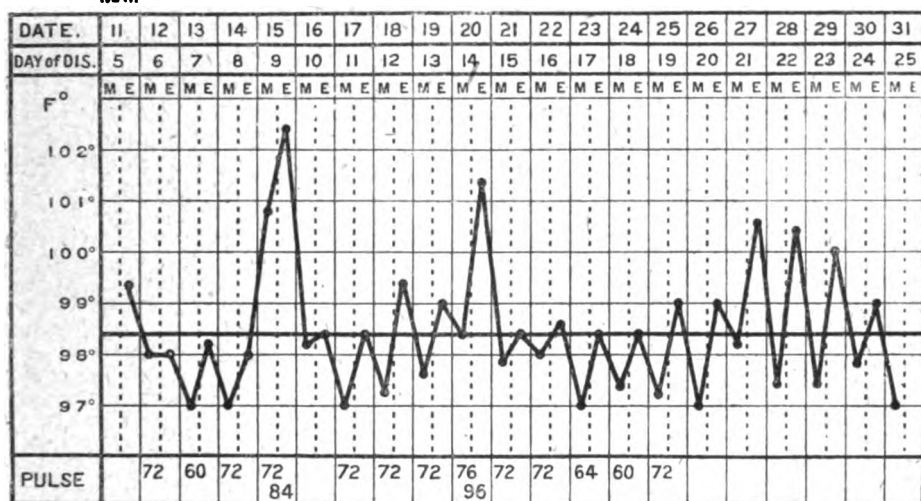


CHART V.

neither instance was it audible in the axilla. In many cases nothing abnormal was noticed till the patient got up, when he had tachycardia and became dizzy and faint, such symptoms persisting unless the patient was put back to bed. The spleen is palpable in a few cases. There is marked tenderness of the shins in some cases; in one case with great pain in the shins there was œdema of the left leg.

There is often marked tremor when patients first get up.

Course.—Of the length of the illness we are unable to speak with certainty, as we only kept patients for twenty-one days; but forty-six cases, or forty-two per cent, were discharged to duty, usually of a light character, on roads, within three weeks of admission to the field ambulance. Regimental medical officers say that the pains in the shins are often very persistent, men complaining of them at night for weeks after their return to duty.

Treatment.—We had no success in attempts to cut short the disease by means of drugs, though we gave a good trial to: (1) Salicylate of soda combined with bicarbonate of soda in doses increasing to forty grains of each every four hours; (2) liquor hydrarg. perchlor. in doses of one dram with iodide of potassium, five grains, three times a day, combined with unguent. hydrarg. co. applied to the shins; and (3) to quinine sulphate in doses increasing to ten grains every four hours.

The main indications for treatment are:—

(1) To keep the patient at rest in bed until the temperature has been normal for forty-eight hours, continuing to keep a careful watch upon the heart after the patient is up.

(2) To keep the bowels well open, starting with calomel three grains, or a No. 9 tablet, then two drams of magnesium sulphate every morning, repeated, if necessary, every two hours.

(3) To ease pain and promote sleep. In order of efficacy we found aspirin twenty grains, at night, the best analgesic; then mustard leaves to the shins; then phenacetin ten grains; then hot sponging the whole body; then tincture of opium $\frac{1}{2}$ dram; then Dover's powder fifteen grains; then pil. opii one grain. All tablets were crushed and given as powders. Painting the shins with iodine had very little effect, and rubbing them with liniment. terebinth. little more.

The Cardiac Condition.—(1) The affection noted was: Dilatation in 21 cases; change in sounds in 38 cases; tachycardia in 3 cases.

(2) Cases placed in groups:—

	Heart affected	Not affected	Percentage of cases affected
(1) Remittent type ..	23 cases	9 cases	74
(2) Relapsing type ..	18 "	20 "	47
(3) Indeterminate type ..	21 "	18 "	54
Total ..	62 "	47 "	57

(3) The effect of *delay in treatment*. The average number of days of illness before admission to this field ambulance was:—

(1) In cases in which the heart was not affected ..	4.75
(2) In cases in which the heart was affected ..	7.15

(4) The effect of different drugs:—

Drug	Tried in	Heart affected in	Not affected in	Percentage of cases in which heart was affected
Liq. hydrarg. perchlor. (with potass. iod.)	19 cases	5 cases	14 cases	26
Quinine sulphate	19 $\frac{1}{2}$ "	7 "	12 $\frac{1}{2}$ "	36
Sodium salicylate (with sodium bicarbonate)	23 $\frac{1}{2}$ "	17 $\frac{1}{2}$ "	6 "	74
Tonic tablets (containing iron, arsenic, quinine and strychnine)	21 "	11 "	10 "	52
Potassium iodide	3 $\frac{1}{2}$ "	$\frac{1}{2}$ "	3 "	14
Phenacetin	$\frac{1}{2}$ "	0 "	$\frac{1}{2}$ "	0
No drugs were given in two cases		1 "	1 "	50

* Two different drugs were tried in the same case several times—each drug was credited with $\frac{1}{2}$ instead of 1 in these cases.

The heart was found to be affected in twenty cases on admission.

From the foregoing figures it would appear :—

(1) That cases of the relapsing type are less liable to cardiac affection than those of the remittent type.

(2) That the earlier a patient is put to bed the less likely is his heart to be affected.

(3) That cases treated with salicylate of soda are more liable to cardiac affection than others. It is only fair to state that the earliest cases of the series were treated with salicylate of soda or tonic tablets, and it was only when affection of the heart was found to be common that patients were strictly confined to bed.

We have heard a good deal of the "irritable heart" of the soldier. Possibly many of these cases of irritability have their origin in trench fever, perhaps treated by a day or two off duty.

These notes are published in the hope that D.A.H. may become less common in the British Army.

A NEW TEST TYPE FOR THE DETECTION OF MALINGERERS IN THE ARMY.

BY CAPTAIN ALAN W. SICHEL.

Royal Army Medical Corps.

*Medical Officer in Charge, No. 58 Ophthalmic Centre, Military Hospital,
Pembroke Dock.*

In examining the visual acuity of men in the Army the Ophthalmic Surgeon has to contend with a great deal of malingering, and in many cases the detection of a malingerer is a matter of some difficulty.

Out of 1,956 cases where the visual acuity was examined at No. 58 Ophthalmic Centre during a period of twelve months, 101 cases of malingering were recorded, representing five per cent of all eye cases seen. During the three months ending November, 1917, the number of such cases has risen to eleven per cent of the total examined.

By malingering in this connexion is meant the refusal of men to admit having as high a visual acuity as they really possess, whether they be emmetropic, or have an error of refraction small or moderate in amount.

Malingering in the Army differs from that met with by the oculist in civil practice in this respect. In the latter case a malingerer usually maintains that he is blind in one or both eyes, or at any rate that he has no useful vision in one or both eyes, in order to claim compensation for an injury alleged to have been caused by his work. In Army work on the other hand the common type of malingerer met with is one who pretends that his vision, while fairly good, is below a certain standard.

This is due to the fact that in classifying men as to their fitness for the various categories as regards visual acuity certain standards are laid down, e.g., to be fit for category A a man must have at least $\frac{5}{24}$ with either eye without glasses, and at least $\frac{6}{12}$ in the right eye with glasses. Thus, in order to be rejected for category A a man must maintain that he cannot see more than $\frac{3}{36}$ with either eye without glasses, or that he cannot see more than $\frac{6}{18}$ with the right eye with glasses.

Familiarity with the medical inspection room and the usual test type therein displayed has enabled men to become acquainted with the card of letters. They know that the large letter ($\frac{6}{60}$) at the top indicates a low standard of vision, and that the lowest line ($\frac{5}{3}$) means a high standard, the intermediate lines from above downwards representing increasingly higher standards.

It may even be possible that some men get to know that the fifth line from the top ($\frac{6}{12}$) is the minimum standard required with or without glasses for category A.

Accordingly it is found in examining the visual acuity that in many cases the larger lines are read with comparative ease, but nothing can

induce the man to read more than $\frac{6}{18}$, even though he is found to be emmetropic, or having an error of refraction when this is corrected by glasses.

In such cases, when the fundus and media are healthy and the eye is emmetropic, or possesses an error of no great amount which is capable of correction, the examiner can only infer that the man ought to see more, and it is obviously a difficult matter to certify the vision to be up to standard when the man declares he cannot see as much as he is expected to.

In order to detect cases of this kind the writer has devised a test card which is intended to prevent the malingerer from judging the standard by the size of the type.

The card consists of successive rows of letters constructed upon the usual principles as in Snellen's test type, but the size of the individual letter varies in each row; thus, the top row consists of five letters which should be read at 9, 6, 12, 9 and 18 metres respectively, the second row of letters which should be read at 18, 12, 6, 9 and 24 metres, the third row of letters which should be read at 12, 18, 36 and 9 metres, and the bottom row of letters to be read at 24, 6, 12, 9 and 18 metres. The distance at which each letter should be read is indicated in small type above the letter. There is no letter on the card of a size which should be read at sixty metres, the largest being one read at thirty-six metres. In addition to the arrangement of the letters as described the card employed is smaller than the ordinary test card and this causes the letters to appear relatively larger. There are also only four rows of type compared with seven on the ordinary card.

On being confronted with a card of this kind the man under examination regards the letter (36), being the largest seen, as equal in size to the top letter (60) on the ordinary card. Starting on this erroneous assumption he is tempted to read letters throughout the successive rows one size smaller than he would otherwise have done. It is a matter of some difficulty even for one accustomed to the ordinary test-type to tell at a glance whether an isolated letter is of a size to be read at 18 or 12 metres, or at 12 or 9 metres, therefore to a man not accustomed to the constant use of such types it is exceedingly difficult.

When the malingerer is asked to read the letters he can see, knowing that it would be foolish for him to say he cannot see even the big letters, he commences to read what he judges to be letters of an intermediate size. If he reads all the letters except those intended to be read at six and nine metres, e.g., the top line on the card with the exception of the two smallest letters, it is at once known that he can read $\frac{6}{12}$, and this is all that is required, the minimum standard for category A being $\frac{6}{12}$ with glasses in the right eye. What actually happens is that the malingerer is absolutely bewildered by an arrangement of letters he has not seen before, and in his confusion he blunders into reading smaller letters than he would have done had he proceeded from larger to smaller type.

It is important in using the new card that all ordinary test types should be hidden from view, or else the man is afforded an opportunity of comparing the sizes of the various letters with the type arranged in the manner to which he is accustomed. It is not maintained that every malingerer can be caught in this way, as there is no known method of compelling a man who refuses to read any but the largest letter visible to admit he can see more; nor is the new card intended to take the place of any of the well known methods for detecting malingerers when these are called for, but after a sufficient trial of the new card it has been shown that the large majority of malingerers of this special kind can be detected.

In order to prove the efficiency of the new type the following routine has been followed. The visual acuity was first recorded as shown by a test card of the ordinary kind. Objective examination in the dark room was then carried out, and the refraction noted. The trial frame having been placed in position the vision of each eye was tested by putting a plain glass in front of it, using still the ordinary card. In a few cases the malingerer would read another line or two with the mere addition of a plain glass, but more often than not he still maintained that he could read only what he declared at first. The new test card was then exposed, all ordinary cards being out of sight. In the cases recorded the men were actually shown to have a higher visual acuity by the mere change of cards. The reverse method, i.e., testing first with the new card, followed by an ordinary card, revealed the same difference.

In routine work the vision is recorded at the outset by means of the new card in order that no opportunity may be afforded for comparing the size of the type, i.e., judging the standard. In this way the actual visual acuity, or the nearest approximation to it, is obtained without loss of time and with a minimum of trouble to the oculist in all but a few cases of malingering. The card has also proved of use in examining the vision of neurasthenic individuals who perhaps read as far as $\frac{6}{12}$ on the ordinary test card and then say, "the rest are blurred." On changing the old for the new type they may read $\frac{6}{9}$, or even $\frac{6}{6}$, without hesitation.

The following illustrative cases are appended, a few of the many that have been examined and detected by this means:—

Case 1.—Pte. W., aged 25. R.V. $\frac{6}{36}$, cum plano = $\frac{6}{36}$. L.V. $\frac{6}{60}$, cum plano $\frac{6}{60}$. Retinoscopy: R. $+4$ X $+7$. L. $+7$ X $+4$. fundus and media normal. With new card: R.V. cum plano = $\frac{6}{9}$! L.V. cum plano = $\frac{6}{9}$! R.V. cum + 1.00 sph. \ominus + 3.00 cyl.₁₂₀ = $\frac{6}{9}$. L.V. cum + 1.00 sph. \ominus + 3.00 cyl.₆₀ = $\frac{6}{9}$. Fit for category A.

Case 2.—Pte. G., aged 29. R.V. $\frac{6}{36}$, cum plano = $\frac{6}{36}$. L.V. ditto. Retinoscopy. Emmetropic. Fundus and media normal. Wearing glasses: R. + 1.00 cyl.₆₀. L. + 0.50 sph. \ominus + 1.00 cyl.₁₁₀. With his own glasses: R.V. = $\frac{6}{24}$. L.V. = $\frac{6}{36}$. With new card: R.V. cum plano = $\frac{6}{12}$! L.V. cum plano = $\frac{6}{12}$!

Case 3.—Pte. J., aged 19. R.V. $\frac{6}{80}$, cum plano = $\frac{6}{80}$. L.V. $\frac{6}{80}$. Convergent strabismus. L. eye amblyopic. Retinoscopy: R. $\begin{matrix} +1 \\ + \\ +1 \end{matrix}$. L. $\begin{matrix} +4 \\ X \\ Emm. \end{matrix}$. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{8}$!

Case 4.—Pte F., aged 29. R.V., H.M. only. L.V. $\frac{6}{24}$, cum plano = $\frac{6}{24}$. Diffuse corneal nebulae and irregular astigmatism in R. eye. L. eye: Retinoscopy. Emmetropic. Fundus and media normal. With new card: L.V. cum plano = $\frac{6}{8}$!

Case 5.—Pte. S., aged 34. R.V. $\frac{6}{12}$, cum plano = $\frac{6}{12}$. L.V. = $\frac{6}{80}$. Retinoscopy: R. $\begin{matrix} -0.5 \\ + \\ Emm. \end{matrix}$. L. $\begin{matrix} -12 \\ + \\ -8 \end{matrix}$. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{8}$! L.V. cum - 8.00 sph. \ominus - 4.00 cyl.₁₄₅ = $\frac{6}{18}$. Fit for category A.

Case 6.—Pte. L., aged 41. R.V. $\frac{6}{18}$, cum plano = $\frac{6}{18}$. L.V. ditto. Retinoscopy. Emmetropic. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{8}$! L.V. ditto. Fit for category A.

Case 7.—Acting-Serjt. B., aged 22. Chelsea Pensioner. Examined for Medical Board. Discharged from the Army with shell shock. R.V. $\frac{6}{80}$, cum plano $\frac{6}{80}$. L.V. ditto. Retinoscopy: R. $\begin{matrix} +5 \\ + \\ +5 \end{matrix}$. L. $\begin{matrix} +5 \\ + \\ +5 \end{matrix}$. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{12}$! L.V. ditto.

Case 8.—Pte. M., aged 18. L. eye enucleated when 6 years of age. R.V. $\frac{6}{12}$, cum plano = $\frac{6}{12}$. Retinoscopy. Emmetropic. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{8}$!

Case 9.—Pte. T. Chelsea Pensioner. Examined for Medical Board. R. eye enucleated owing to G.S.W. L.V. $\frac{6}{24}$, cum plano = $\frac{6}{24}$. Retinoscopy. Emmetropic. Fundus and media normal. With new card: L.V. cum plano = $\frac{6}{8}$!

Case 10.—Gunner T., aged 23. R.V. $\frac{6}{12}$ pt. cum plano = $\frac{6}{12}$ pt. L.V. ditto. Retinoscopy. Emmetropic. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{8}$! L.V. ditto. Fit for category A.

Case 11.—Gunner O'C., aged 46. R.V. $\frac{6}{80}$, cum plano = $\frac{6}{80}$. L.V. $\frac{6}{80}$ cum plano = $\frac{6}{80}$. Retinoscopy: R. $\begin{matrix} +3 \\ + \\ +3 \end{matrix}$. L. $\begin{matrix} +3 \\ + \\ +3 \end{matrix}$. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{18}$! L.V. ditto. R.V. cum + 2.00 sph. = $\frac{6}{8}$. L.V. ditto. Fit for category A with glasses.

Case 12.—Pte. T., aged 27. R.V. $\frac{6}{18}$, cum plano = $\frac{6}{18}$. L.V. = $\frac{6}{80}$. Central nebula of cornea in L. eye. Retinoscopy: $\begin{matrix} -1 \\ X \\ +2 \end{matrix}$. R. eye. Retinoscopy. Emmetropic. Fundus and media normal. With new card: R.V. cum plano = $\frac{6}{8}$! L.V. cum + 1.00 sph. \ominus - 3.00 cyl.₁₅ = $\frac{6}{36}$. Fit for category A.

A specimen copy of the card described—actual size as used—is appended.

18
T

24
O

9
P

9
A

12
H

6
F

6
V

12
D

9
Z

18
N

9 E

18 L

36 H

9 X

12 N

18 Z

6 L

12 U

24

A

HERNIA OF THE FORAMEN OF WINSLOW: OPERATION AND RECOVERY.

BY LIEUTENANT H. E. RAWLENCE.
Royal Army Medical Corps.

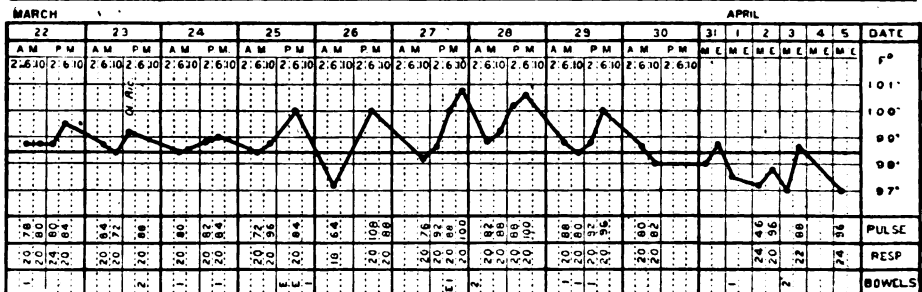
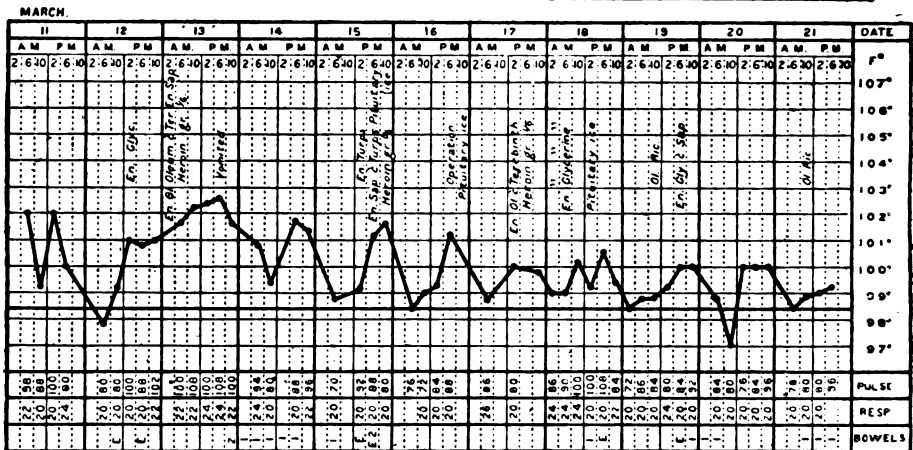
Pte. "B.," R.W.S., aged 18, service one year and four months. Wounded in France, February 2, 1916. Admitted into Military Hospital, Brockenhurst, February 18, 1916. Wound of the left thigh in its upper third on the outer side. The shrapnel passed from above down and out, tunnelling under the skin for some six inches. On admission, the parts appeared healthy, and there was very little discharge. February 23: Tube shortened and some stitches removed. February 28: Wound of entrance healed.

Clinical History.—March 1, 1916: Patient was suddenly attacked with severe abdominal pains. The pain was above umbilicus and chiefly on the left side. Patient was obviously ill and had an anxious expression. Abdomen soft and distended. Temperature 101° F.; pulse 120; respiration 26. March 2: Patient better, tongue clean, no distension; bowels moved twice naturally. March 3: After mist. sennæ co. and a large enema several large faecal masses were brought away. March 4: Patient bright and much better. March 7: Report of blood, urine, and faeces, from the R.V. Hospital, Netley, negative as to enteric and dysentery. Patient taking food well and tongue clean. March 8: A good deal of flatulence but no pain. March 9: 5 p.m., attack of very acute pain: after ol. ric. and soap and water enema he passed a loose motion with a lot of flatus, and was relieved. March 12: Another attack of severe pain relieved by glycerine enema, but recurred again in the night. March 13: A distinct feeling of resistance present for the first time above the umbilicus and more marked on the left side: Patient vomited for the first time. Rectal examination and urine negative. March 15: Another attack of pain, this time of a most violent character; patient vomited and perspired freely. Two enemas failed to relieve. A definite tumour, which gave a tympanitic note, could now be felt above the umbilicus. March 16: Patient feeling better, but tumour still present and in the same situation. Patient seen in consultation with Lieutenant-Colonel Alpin, Officer Commanding, it was thought that the obstruction was in the colon, and was probably secondary to some inflammation near the left kidney. Possibly a deep lumbar or peri-nephric abscess, consequent upon the sepsis in the wound which was in the left thigh.

Operation.—March 16, 1916: Colonel Alpin kindly assisting, chloroform was given by the open method by Lieutenant W. M. Jackson. The patient was turned on his right side, the left kidney region was incised over a length of two inches, and a pair of forceps pushed into the lower pole of

the left kidney. Nothing was found, and a finger introduced palpated the region with negative results. The patient was turned on to his back, and a left rectus incision made five inches long, three inches above and two inches below the umbilicus. The peritoneum was not inflamed. The whole bowel was distended with gas. The colon was empty except for flatus. On passing the hand into the abdomen a mass was felt just to the left of the middle line, in the region of the duodenal-jejunal flexure. The stomach and colon were drawn down and out, and the meso-colon exposed. The mesentery appeared quite normal, except for a tense semi-fluctuating mass behind it. The mesentery was carefully opened through and the lesser cavity of the peritoneum found to contain a coil or two of very distended bowel. It was now evident that the condition was a hernia of the foramen of Winslow. The hole in the meso-colon was now isolated; the bowel was hastily eviscerated into hot towels, and the jejunum about four to six feet from the duodenal-jejunal flexure was found firmly fixed in the foramen. By careful manipulation a small length of bowel was withdrawn. The gut now became fixed. One finger of the left hand was passed into the cavity of the lesser sac, and by careful pressure a tergo and traction a fronte another five or six inches of gut was withdrawn and the last piece of jejunal bowel released. (Without the finger in the lesser sac helping to get gas and liquid faeces passed on down the gut, I do not think it would have been possible to have freed this loop of bowel.) The eviscerated bowel was replaced, the hole in the transverse meso-colon was closed by a purse-string suture and the abdomen closed in layers. Patient was placed in the Fowler position in bed, and continuous normal saline, twenty ounces, with one cubic centimetre pituitary extract B.W. and Co., given per rectum at once. March 16: Patient has made a rapid recovery. March 17: Took fluid by the mouth. Glucose 2 per cent proctoclysis given continuously. March 18: Bowels well opened with a glycerine enema, copious fluid result. Temperature not above 100° F., some pain still experienced in the old position. March 25: Up to this evening patient had been well, then he had a sharp attack of vomiting, with cramp-like pains in the upper half of the abdomen. March 28: Patient much better. Temperature 100° F. at night; pulse 80. Stitches out, wound healed per primam; patient hungry, taking food well, and bowels acting regularly. April 5: Allowed on to a couch. April 16: Sent to an Auxiliary Hospital, Class B. Patient very fit and putting on flesh.

Summary.—Up to the present time, as far as the writer can find in the literature, twenty cases of hernia of the foramen of Winslow have been reported. Blandin was the first to recognize this condition, and published in 1834 the first report of such a case. He was followed by Rokitsansky in 1842, and by Majoli in 1884. Our first real knowledge of the subject seems to be the work of two English surgeons, Elliott Square in 1886, and Sir Frederick Treves in 1888. In the *Lancet* of October 13, 1888, Sir Frederick Treves reported a case with post-mortem findings. This class



of hernia he concluded to be the seventh and rarest form of internal hernia properly so-called. The statistics of the cases reported so far are not very detailed, thus of 16 cases, 13 were men and 3 were women. The age varied, the youngest patient being aged 8, and the oldest 77 years. Out of 20 cases, 18 had laparotomy performed with only 4 recoveries, a mortality of 78 per cent. The patient now reported is a male, aged 18. He is short and well built, and made a good recovery.

Etiology.—To Moynihan we owe our knowledge of the etiology of this condition. It was supposed to be due mainly to some violent effort, but as Moynihan points out the abdomen is generally congenitally abnormal in one of four ways. There is: (a) A common mesentery for the whole intestine; (b) absence of the secondary fusion of the ascending colon to the posterior abdominal wall; (c) abnormally large size of the foramen of Winslow; (d) abnormal length of the mesentery. In the particular case here brought under review it will have been noticed that an incision was made to the left of the middle line, and that the foramen of Winslow was within easy reach. The object being the recovery of the patient, and remembering Murphy's dictum to "get into the abdomen quick, but out quicker," we did not stop to examine the morbid anatomy. However, on looking over my notes and retracing the steps of the operation, I can feel quite sure that some abnormality was present—probably causes (b) and (c) as above enumerated. The foramen, after the removal of the jejunum, was very tight antero-posteriorly—only admitting the tips of the first and second fingers. There was some ecchymosis and very distinct thickening and œdema round the portal vein, hepatic artery, and bile duct. So that undoubtedly the foramen was large before the hernia occurred.

Morbid Anatomy.—In most of the cases examined so far the cæcum and colon had become herniated. This was so in Sir Frederick Treves's case. One case is reported in which the ileum was involved a short distance above the ileo-cæcal valve. With the exception of the above case, the literature contains no record of the small intestines or jejunum having become herniated. In the present case the jejunum about six feet from the duodenal-jejunal flexure entered the hernial sac. There was not a great quantity of bowel in the sac; some came away towards the lower portion of the jejunum quite easily, having evidently only quite recently prolapsed. About seven inches or more of the bowel showed signs of having been long in the hernia. After the jejunum had been withdrawn the bowel was in good condition, slightly inflamed with a good deal of œdema of the walls, and near the duodenal end in two places there were fairly extensive sub-peritoneal hæmorrhages. The peritoneum of the lesser cavity was injected and had some serous fluid in it. There was no lymph present nor any signs of peritoneal infection.

Symptoms.—In most cases curiously enough this condition has lasted for as many as six to fourteen days. The pain in all cases has been mostly above the umbilicus, in the present case slightly to the left of the middle

line. The vomiting in nearly all cases has been delayed. The abdomen distended and tympanitic. The only respiratory symptoms present have been a marked rapidity of respiration. In nine of the reported cases it is mentioned that "tumefaction of the supra-umbilical space" was present. In the case now reported this was also very evident. Jonnesco has very graphically described the condition; his description is worth recording: "Je circonscrivais en effect à l'endroit déjà dit, un corps résistant de figure elliptique irrégulière à grand diamètre transversal de 6 centim. Environ à petit diamètre vertical de 3 centim." The man's bowels were moved freely several times during the period of illness before operation. In the present case the tumour was tympanitic the whole time. In some cases the patients have exhibited a marked tendency to keep sitting up.

Diagnosis.—This will always remain a difficult problem. It is hard to pick out from among the many cases so far reported any symptoms which would be in any way characteristic. The one thing about the tumour which differentiates it from most others in that part of the abdomen is its size and its percussion sound. The quality of tympanites is absent over tumours in this position, due to intussusception cysts, gastric tumours, or any form of carcinoma.

Treatment.—In the first place exploratory laparotomy. Two main methods may now be employed. Jeanbran and Riche strongly recommend Wiat's exposure of the common bile-duct as a means to open up the foramen of Winslow, and by enlarging it to enable the bowel to be withdrawn. On the other hand, Moynihan strongly advises an opening being made through either the gastro-colic or gastro-hepatic omentum. Without being aware of either method (at the time of operation) in the present case the transverse meso-colon was opened just as in a case of gastro-jejunosomy. The last nine inches of bowel was extracted with the right hand in the lesser cavity and the left hand at the foramen of Winslow. Owing to the antero-posterior tightening of the foramen of Winslow the contents of the bowel first withdrawn had all been milked back into the last segment to remain within the hernia. It was only by gradually expressing the contents of the bowel from within the lesser cavity that the segment could be freed from its contents and withdrawn. The opening through the transverse meso-colon in this case certainly gave the best access to the foramen from within the lesser cavity and enabled the fingers to act without difficulty, reaching each other easily and not continually pressing upon or displacing the abdominal viscera, as would be the case in an opening through the gastro-colic or gastro-hepatic omentum.

In conclusion I have to express my thanks to Lieutenant-Colonel W. Alpin, I.M.S., Officer Commanding, for permission to publish this case and also for his kind assistance at the operation. My thanks are also due to Staff Nurse S. S. Wilson for her unremitting care and attention to the nursing of the patient both before and subsequent to the operation.

REFERENCES.

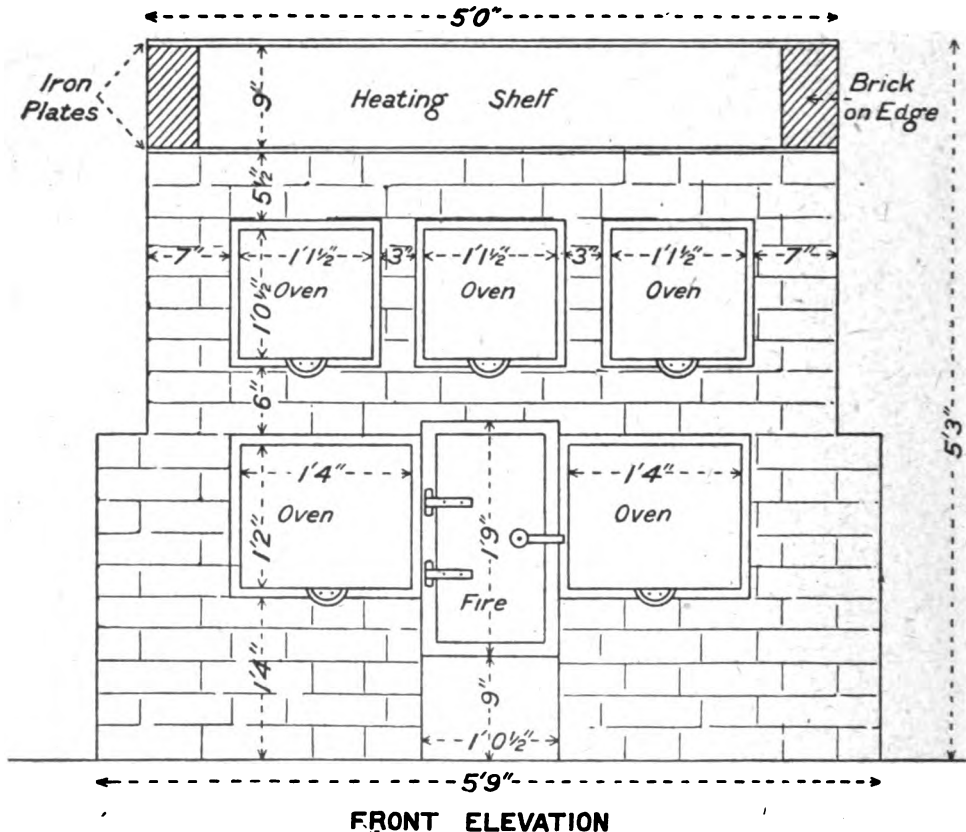
- ELLIOTT SQUARE. "A Case of Strangulated Hernia into the Foramen of Winslow," *Brit. Med. Journ.*, 1886, i, p. 1163.
- TREVES. "Clinical Lecture on Hernia in the Foramen of Winslow," *Lancet*, 1888, ii, p. 701.
- MAJOLI. *Rivista clin. di Bologna*, July, 1884.
- BLANDIN. "Traite d'anat. topographique," 1834, p. 467.
- TREITZ. "Hernia retro-peritonealis," Prague, 1857, p. 126.
- JONNESCO. "Hernies internes retro-peritonealis," chapter 4, Paris, 1890.
- MOYNIHAN. "Anatomy and Pathology of the Rarer Forms of Hernia," Arris and Gale Lectures, *Brit. Med. Journ.*, 1900, i, p. 435, February 24.
- "Keen's Surgery," vol. iv, p. 103.
- JEANBRAN and RICHE. *Revue de Chirg.*, 1906, vol. iv to v.
-

Clinical and other Notes.

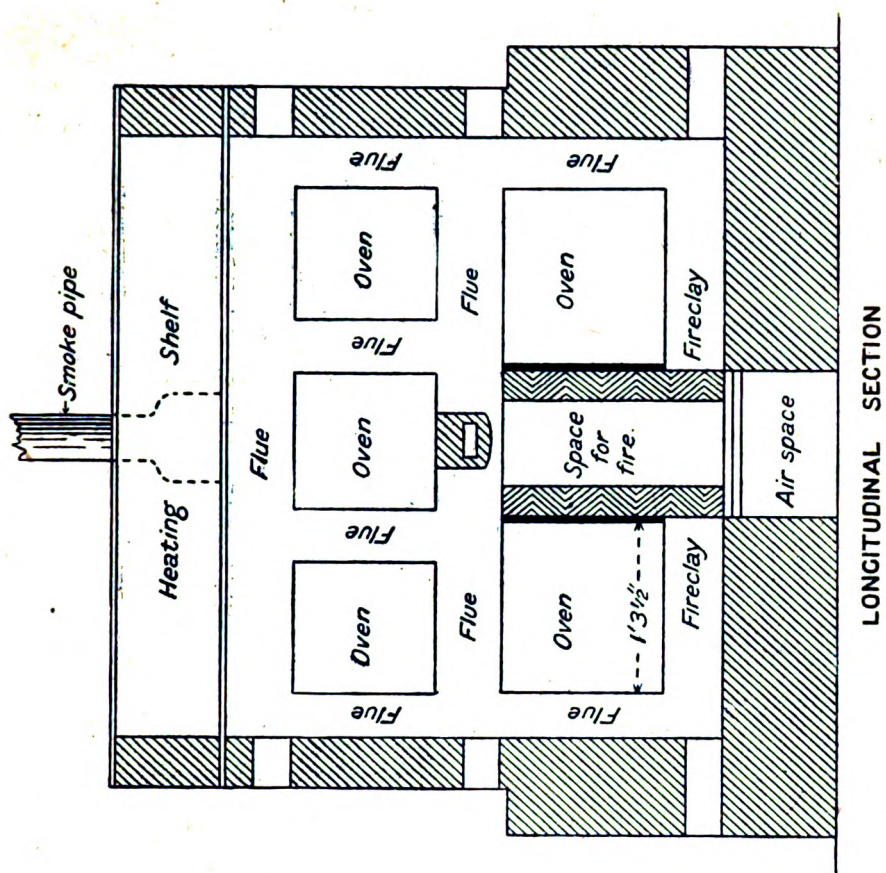
A SYSTEM OF ERECTING PORTABLE STOVES SUCH AS ARE ISSUED TO MEDICAL UNITS, SO AS TO FORM AN EFFICIENT AND ECONOMICAL INDOOR COOKER.

BY LIEUTENANT AND QUARTERMASTER R. D. MATTHEWS.
Royal Army Medical Corps (T.F.).

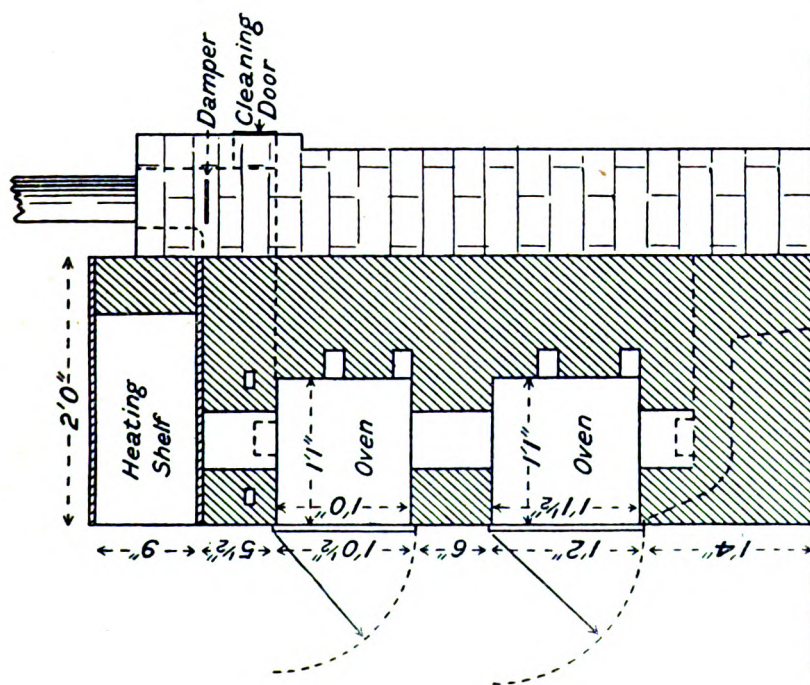
SOME time ago, when we "covered in" our open-air kitchen and made it into a cook-house, we were much concerned as to the amount of smoke and soot caused by the fires of the portable stoves of the regulation pattern issued to field ambulances and casualty clearing stations, and it occurred to me that I might remedy this.



I now forward herewith a drawing showing the manner in which we overcame the difficulty by constructing a cooker with a series of five ovens, at the same time reducing considerably the amount of fuel required for heating them.



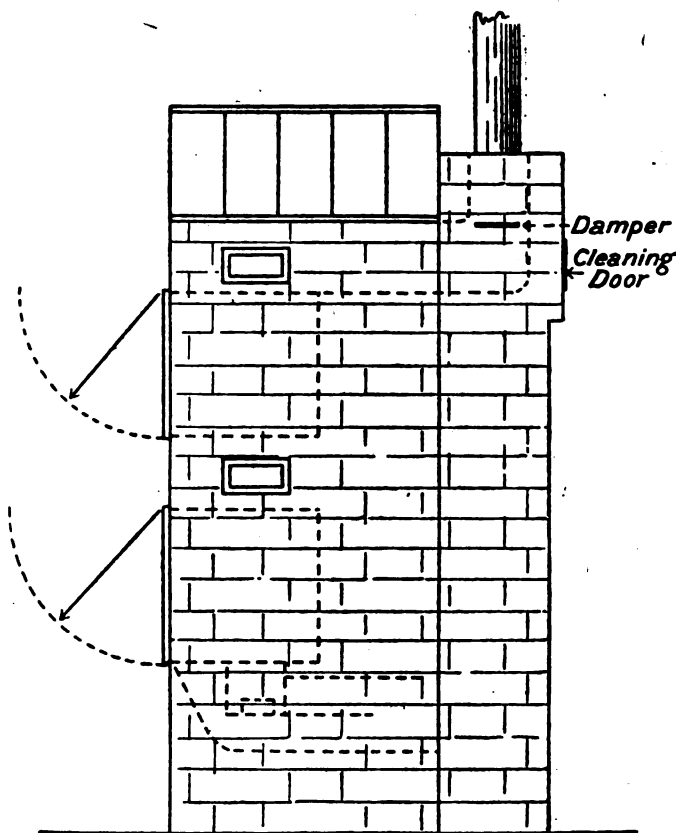
LONGITUDINAL SECTION



CROSS SECTION

The ovens are built into a brick setting with one fireplace for the five ovens, and with flues so arranged as to conduct the heat around the four sides of each oven, a damper being fitted at the smoke pipe whereby the heat can be controlled. At the top of the setting a heating shelf has been made of corrugated iron which is found to be very useful for keeping warm puddings, joints, etc., after they have been cooked sufficiently.

Ordinary bricks may be used throughout, but where fire-bricks are available they are to be preferred in those parts of the cooker which are in direct contact with the flame.



END ELEVATION

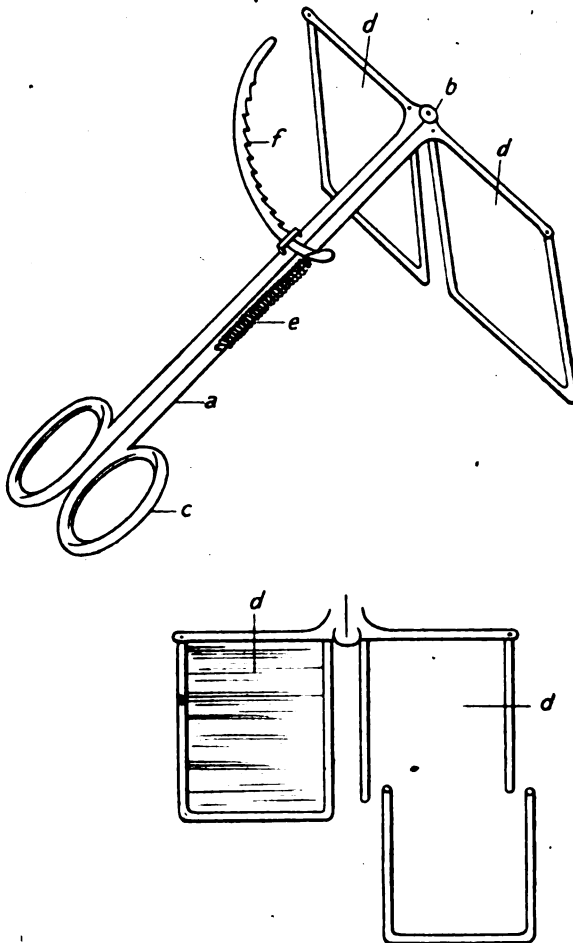
By using this cooker we get rid of the smoke and soot by the smoke pipe through the roof, a much steadier heat is obtained and consequently there is a saving of meat by preventing charring of the surfaces whilst allowing the interior of the joint to be properly cooked. There is a saving of quite fifty per cent in the consumption of coal, and the life of the ovens is more than doubled. The cooker is ready for use within an hour of lighting up, and the five ovens, as shown, are sufficient to cook "roasts" for 150 patients. In addition to roasting meat, milk puddings, bread-baking or any other class of cooking can be accomplished.

The design is so simple that men can be found in any unit who will be able to construct a cooker of this description. Three other cookers of this pattern have already been built by other units in France, and are giving very satisfactory results.

INTESTINAL RETRACTOR.

By CAPTAIN W. S. RICHARDSON.
Royal Army Medical Corps.

THIS retractor consists of two horizontal portions 9 inches long (a) with a hinge at one end (b) and two ringed handles at the other (c). At the hinge end are two vertical diaphragms, covered, when in use, with gauze (d). Each



diaphragm measures 3 inches by 3 inches and is made telescopic so to suit the depth of the wound in which it is to be used—it can be pulled out $5\frac{1}{2}$ inches to 6 inches. On the horizontal part is a ratchet arrangement (f)

controlled by a spring (e) so that the retractor may be opened at any angle up to two right angles, when it is used at its maximum utility.

Gauze bags are made of two thicknesses of gauze and stitched over the vertical diaphragm so that the gauze is taut when the diaphragm is pulled out $5\frac{1}{2}$ inches or 6 inches.

This retractor has proved most useful when portions of fixed gut deep down in the abdomen have to be sutured or stitches put into the bladder. An area of at least 33 square inches can be kept free from intestine, and one can work at a depth of $5\frac{1}{2}$ inches to 6 inches without moving the patient.

The retractor may be introduced into the wound with the diaphragm approximating, and by bringing the handles (horizontal portion) together the required area, free from intestines, may be obtained.

This instrument was made for me by Maw, of London.

THE USE OF THE HAY COOKING-STOVE ON ACTIVE SERVICE, A MEANS OF SAVING FIFTY TO EIGHTY PER CENT OF FUEL.

By MAJOR L. REYNOLDS.

Indian Medical Service.

THE difficulty of providing sufficient fuel in the field for cooking purposes is often exceedingly great and consequently any method which will lead to economy of fuel is worth considering.

The hay cooking-stove has been talked about a good deal at home, but the possibilities of this form of cooking have not been taken advantage of on active service, so far as I know.

I will first describe the hay cooking-stove and then explain how it can be adapted for use on active service.

THE HAY COOKING-STOVE.

Take a cooking-pot and a box twelve inches higher and twelve inches deeper than the pot. Put a layer of dry hay six inches deep in the box, place the pot in the middle, surround it with hay and then remove the pot. A nest has been made for the pot.

Now put the food into the pot (vegetables must be sliced, meat should not be more than $\frac{1}{2}$ inch thick) and add sufficient water. * As no water escapes, the usual quantity of water should be reduced to two-thirds, otherwise the gravy is very thin and the food loses in taste. Put the pot on the fire and bring it up to the boil. Rest the lid on the pot so that it gets heated up, but do not shut it down or it may boil over or be blown off. Directly it boils adjust the lid, remove the pot from the fire and place in the hay nest already prepared and then fill up the box with hay at once and shut the lid of the box or put something heavy on top to press down the hay fairly tight.

The hay-stove must be placed close to the fire and the pot must be transferred from the fire to the hay as rapidly as possible so that the loss of heat is at a minimum. The hay must be dry. Water is a good conductor of heat and so is wet hay. After the pot has been in the hay-stove for two and a half hours the

meal is cooked. The food cannot be overcooked, but as time goes on it gradually loses heat.

Advantages of the Hay-stove.

(1) As far as fuel is concerned, directly the pot boils no more fuel is required. Of course the time taken to bring the pot to boil depends on many factors. Let us suppose that it takes twenty minutes and that, cooking in the ordinary way, the food is cooked one hour after it has come to the boil. In this case the hay cooker will cook four meals with the fuel sufficient for one meal used in the ordinary way, i.e., the fuel has been cut down seventy-five per cent.

(2) As soon as the pot is in the hay-stove, it requires no further supervision at all. In fact, it must be left rigidly alone until the meal is cooked. This is a great saving of labour which may be used for other purposes.

(3) The resulting meal is very nicely cooked and yet a child could cook it after being shown the way.

Rationale of the Hay Cooking-stove.

The action of the hay cooking-stove depends on two facts.

(1) To cook food it is not necessary to keep it at the boiling point. As a matter of fact it is better cooked if it is kept a few degrees below 100° C.; a cook knows that "galloping" means tough meat, and galloping is no more than 100° C.

(2) If the temperature of a good conductor of heat be raised and then surrounded on all sides by a bad conductor of heat, the former cools down very slowly. The thermos flask is a well-known example of this.

Bearing these facts in mind it is quite easy to make a hay cooking-box without any hay or box. I have made a few experiments to see what can be done.

Boosa can nearly always be got and is just as good as hay.

Earth can always be obtained and if really dry acts quite well. The disadvantages of earth are: (1) that it picks up moisture very rapidly; (2) if bone dry it is more difficult to keep out of the cooking-pot, although this is quite easily managed, as I will show later.

Instead of a box, a hole can be dug in the ground. The following method is quite satisfactory:—

Dig a hole in the ground the same size as the box of a hay-stove (see above). Fill up to six inches from the bottom with dry earth or sand, taken from the surface to ensure that it is dry. Throw away the earth dug out of the hole and have enough dry earth handy to fill up the hole when the pot is in place. When the pot boils, adjust the lid, throw a piece of cloth over the lid to prevent any earth getting into the pot. Then fill up the hole at once with dry earth and press it down. At the end of two and a half hours remove the pot, brush off the earth from the cloth, remove the cloth carefully so that no earth gets into the pot. The meal is now cooked.

In wet weather this method is of course impossible out in the open. Indoors, with a supply of boosa, or dry earth if boosa cannot be obtained, it can be carried out. The boosa or dry earth can be used time after time. This method of cooking is extremely easy to manage and only requires a little care.

The essential points are:—

(1) The material forming the nest for the cooking-pot must be a bad conductor of heat and, therefore, must be quite dry.

(2) The food must be put into the pot before this is put on the fire. If the food is put into boiling water, then it must be left on the fire a few minutes after the pot boils before placing in the hay-stove.

(3) The food must not be in too thick pieces, otherwise it will not be properly cooked (see above).

(4) The hay-stove must be quite close to the fire, and no time lost in transferring the pot and covering it up.

There should be no difficulty in using the hay-stove on active service and thus effect a very great economy in fuel and consequently in transport which can be used for other purposes.

In Mesopotamia, where the difficulties of transport have been so great, this method of cooking should be particularly useful.

A SIMPLE AND RAPID WAY OF MAKING AN OFFICE TABLE.

BY MAJOR L. REYNOLDS.

Indian Medical Service.

Materials required.—Eight "Ideal milk" boxes (48-tin size), six "Tanglefoot" wooden boxes, a few planks put together like a bed board, to form the table top (say 6 feet by 3 feet), and a few odd pieces of wood.

Construction.—Remove the lids from all the boxes. Place one milk box bottom upwards on the ground. Take three milk boxes and knock out one end, and then pile them on top of the box already placed on the ground, bottom

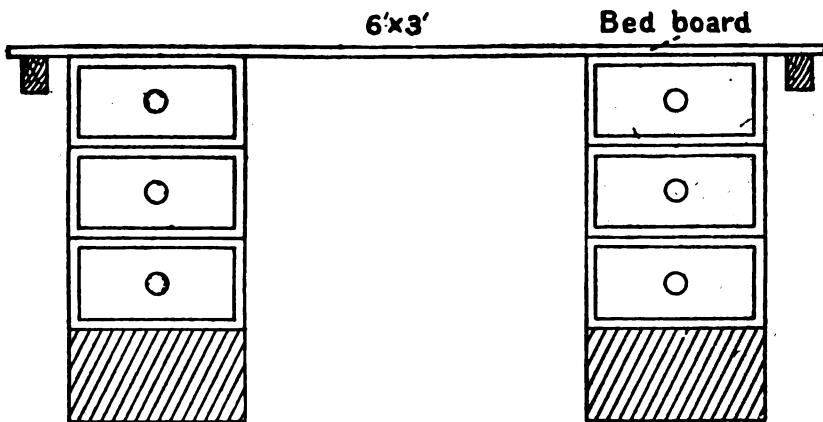
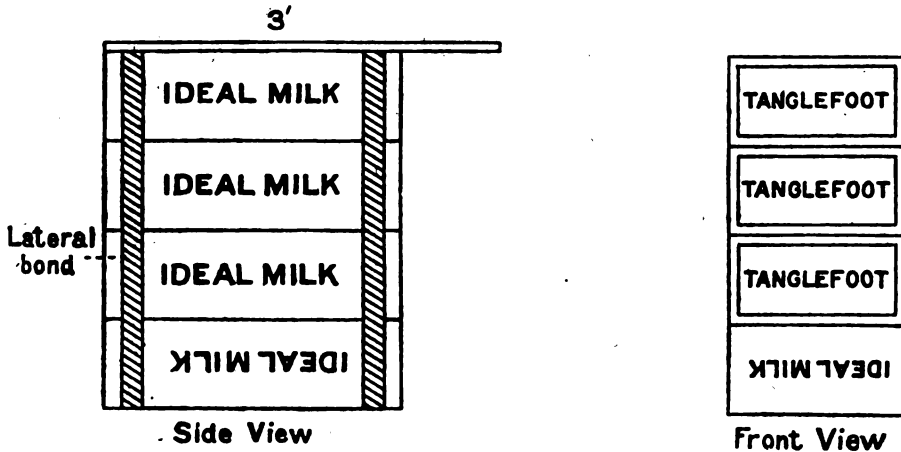


Table Complete.

downwards and the open ends all facing the same way. Now cover the top box with pieces of packing-case wood. This cover is flush with the edge of the pile of boxes towards the open ends and at the two sides, but extend backwards for about six inches, to give a better support to the table top. Fasten the whole pile together with two strips of wood on either side. Slide a "Tanglefoot" box into each of the three upper milk boxes. Fix in some small pieces of wood to

make the drawers fit and prevent them from being pushed in too far. Put handles on drawers. Cover the whole pile of drawers with some cheap cloth to keep out the dust and fix with tin tacks. Now do the same thing with the



remaining boxes. The two supports for the table-top are now ready. The table-top is now made and placed in position. I have had a table made on these lines. It was made in a few hours and is very satisfactory. Diagrams are attached. If the faces of the drawers be planed and rubbed with oil it gives a good finish.

PLAN FOR BUILDING A PACK-STORE WITH MINIMUM MATERIAL, LABOUR AND SPACE.

By MAJOR L. REYNOLDS.

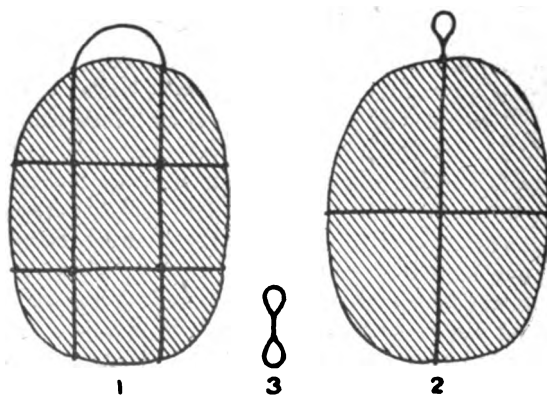
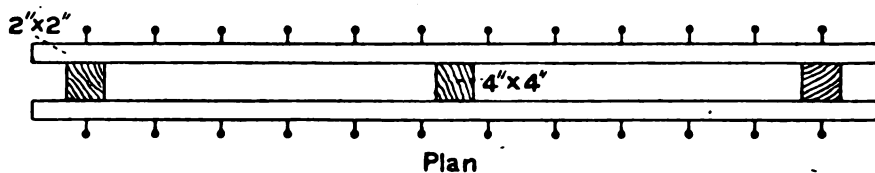
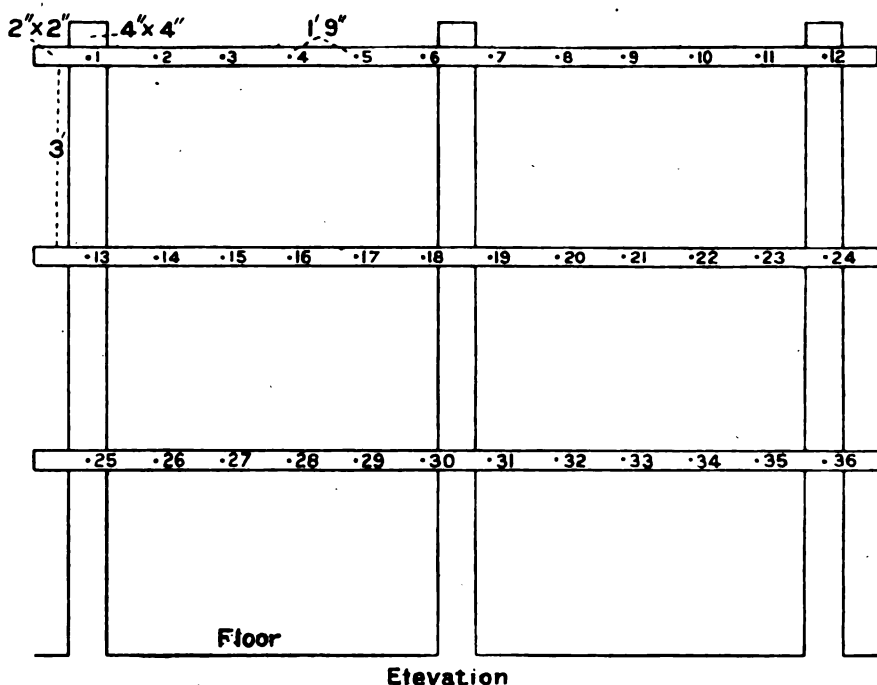
Indian Medical Service.

Material required for 500 Beddings.—Twenty-one pieces of 4-inch timber 12 feet long. (If built in the corner of a building with strong walls only twelve pieces will be required.) Forty-two poles or pieces of 2-inch by 2-inch wood, 21 feet long (or eighty-four pieces of 11 feet long). 600 nails, 6 inches long.

Plan (see Diagram).—The 4-inch timber is used as uprights, sunk 3 feet in the ground, leaving 9 feet above the ground. The uprights are arranged in seven rows, three in each row, with five-foot gangway between rows. The poles are arranged in pairs, one on either side of a row of uprights; there is three feet between the ground and the first pair of poles, and the same between the first and second pairs and between the second and third pairs. The six-inch nails are driven into the poles, leaving an interval of one foot nine inches between two nails; the nails are numbered. The pack store is now complete.

The beddings are tied up as shown in the diagram and are hung from the nails by the loop at the top of the bedding.

This plan can be easily modified to suit local conditions.



METHODS OF TYING UP BEDDING.

No. 2, more economical in rope, requires a small piece of rope with loop at each end. This is passed under the rope binding the bedding, then the loop at one end is passed through the loop at the other end. The bedding hangs by the free loop.

The space occupied by the above-described pack store is twenty-one feet by thirty feet. This is very much less than that taken by the ordinary pack store.

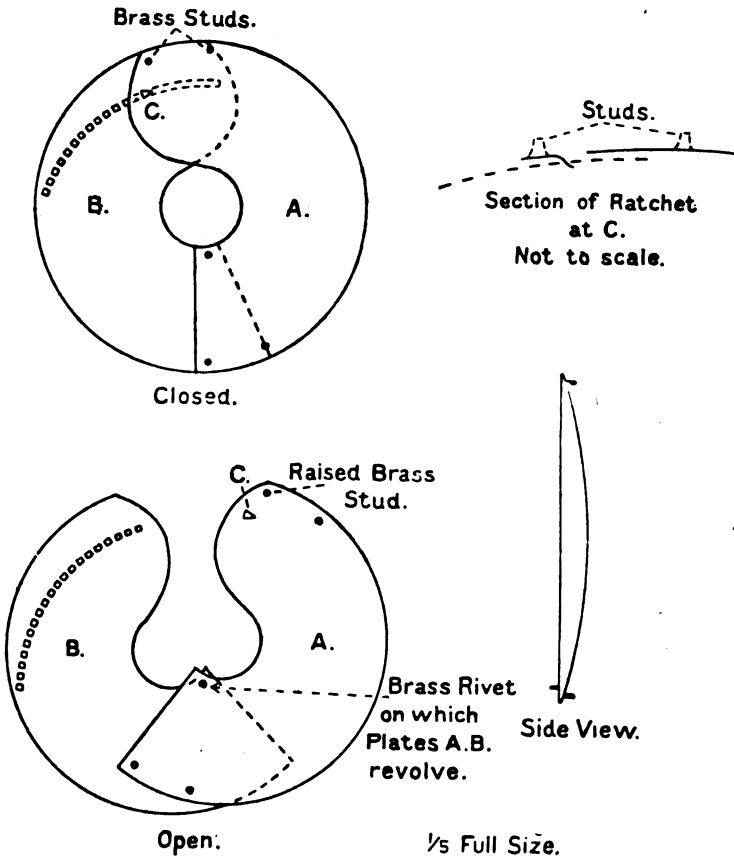
A pair of steps which will stand by themselves, four feet six inches high, is very useful for arranging the beddings. Plan attached.

IMPROVISED AMPUTATION SHIELD.

BY CAPTAIN VALENTINE H. BLAKE.

Royal Army Medical Corps.

DURING a short but strenuous period of work at a casualty clearing station taking "walking wounded," I was struck with the need for an amputation shield. When there is a heavy press of work it is not always possible to have a clean assistant to retract the flaps, with the result that the single-handed operator is harassed by loss of time and sometimes by finding he has not been able to remove enough bone.



Colonel T. Sinclair, Surgeon Consultant to this unit, very kindly offered some suggestions, with the result that I was able, with the help of Lieutenant R. C. Foster, R.E., to get the following apparatus made:—

Two semi-circular sheets of stout brass are hinged by a single rivet and slightly dished to give the hand and saw free play. A circular slot cut in the centre allows the shield to be adjusted to the bone, and a tongue of metal on one leaf operating on slots on the other leaf forms a quickly acting ratchet holding it in place at the most convenient position. Studs are provided on the covering plate so that the whole can be very strongly retracted by loops of bandage held by assistant who is well out of the way.

In practice, the shield is very rapidly applied and adjusted, giving ample room for the surgeon. There is no fear of the leaves giving or separating, for the greater the pull by the assistant, the more firmly do the plates hold. I have not provided a slot for the fibula in amputations below the knee, but I could do so without any difficulty and without spoiling the efficiency for femur and humerus operations. The brass was cut from two 18-pounder shell cases.

The plates are $8\frac{1}{2}$ inches across, dished one inch. The studs, $\frac{1}{2}$ inch long, are placed on the circumference of the covering plate, one at each corner and one at each diametrically opposite point.

The slots in the covered plate are set at a slight angle to facilitate engagement with the tongue in the plate above.

I submit this note with the kind permission of Lieutenant-Colonel A. H. Morris, R.A.M.C.

A CASE OF "TRENCH FEVER" CONTRACTED IN ENGLAND.

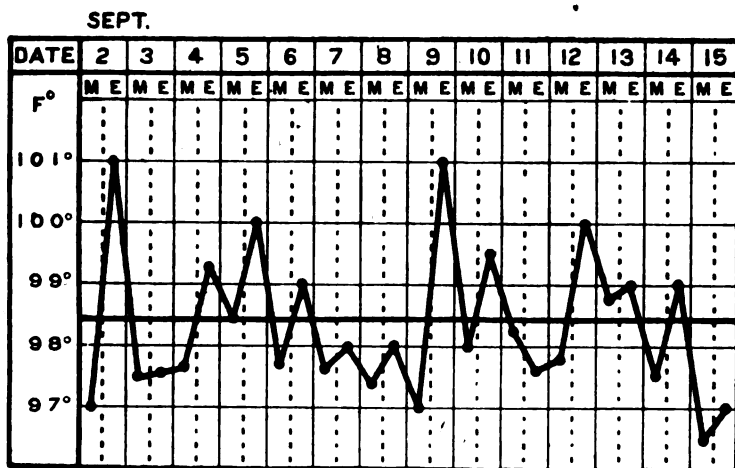
BY CAPTAIN R. D. MACGREGOR.
Indian Medical Service (Retired).

THE case of "trench fever" here described is recorded because the patient has never been out of England, and has contracted the disease while in hospital in attendance upon cases of trench fever from France. As has been the case in a number of instances occurring abroad, the patient is a Royal Army Medical Corps orderly.

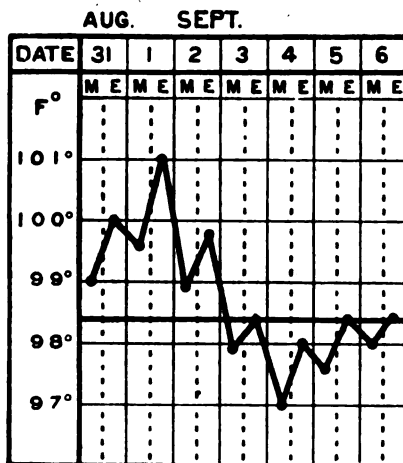
Pte. A., R.A.M.C., has been employed for some months at this hospital as a ward orderly, and bears a good character. He is aged 54, and has had no serious illness except appendicitis, for which he has been operated upon. He has never had rheumatism.

On August 30, 1916, he had acute pain in his legs all night. For three days before this he had had some aching in the legs, but had carried on with his duties. On the morning of the 31st his legs were so acutely painful that he could not stand, and was brought up to the hospital on a stretcher. On admission the fronts of the legs were found to be very tender to the touch, this being most marked along the inner border of the tibiæ. There was headache, and some tenderness and pain over the front of the thighs. Temperature in the evening 100° F. On the next day the evening temperature was 101° F., the symptoms continuing the same. On the fourth day the temperature came down to normal, and remained so thereafter, but there was but little remission in the pain. He was not able to stand with ease until about the seventh day. In addition to the leg pains, headache was frequent, and pains began to locate themselves in different parts of the body—transversely across the chest below the nipples, in the

neighbourhood of the hips and of the shoulders. At the present date (November 5) there is pain, which he describes as "cruel" in the left shin, but none in the right. There is also pain in the right shoulder. Pains are usually worse at night and in damp weather. Throughout the illness, there have been no pathological signs except the initial pyrexia.



Pte. T. Twelfth week of "long" type of trench fever.



Pte. A. "Myalgic" type of trench fever. (Contracted in England.)

The case is a fairly typical one of the "myalgic type" of trench fever. Trench fever, as it has been described up to date, has no completely uniform character, but presents a symptom-complex easily recognized and divisible into a number of well-marked types. McNee, Renshaw and Blunt [1], also Hurst [2], have described a "long" and a "short" type of trench fever. To these Houston and McCloy [3] have added the "myalgic" type, as well as "septicæmic" type.

The case described above belongs to the "myalgic" type, which in general characters is very similar to the other types, but differs in having a short duration

of pyrexia with a long duration of the pains. The myalgic type of patients and the "long" trench fever type in this hospital differ only in the temperature chart, which in the first named shows but a few days' pyrexia, while in the second a course of low irregular pyrexia extending over many weeks is shown with occasional spikes rising a degree or too higher.

The "short" type of trench fever has not been seen in this hospital, possibly because such cases do not find their way over from France. The "septicæmic" type of Houston and McCloy has also not definitely been established here.

It is notable that the various types merge into one another, thus showing the essential identity of the symptom-complex of trench fever. There is no catarrh nor definite joint pains, but a variety of exceptional symptoms may occasionally give rise to diagnoses of "gastralgia," "influenza," "rheumatism," etc.

The excessive duration of fever and pains in the "long" type, and of pains alone in the "myalgic" type, were at first a source of concern, because the weeks went on without any apparent end to the condition. The physical state of the patients seldom gave cause for anxiety, but no form of treatment tried appeared to effect a cure. The passage of time, however, has shown that the most obstinate case finally yields to the "*vis medicatrix naturæ*," though the longest case took as many as fifteen weeks to do so. There is a gradual amelioration of the pains, the malaise disappears, and the temperature gradually settles upon the normal line.

In the case of Pte. A., given above, the pain has latterly occurred in the left shin only. This is exceptional, only one other case with this peculiarity having been seen, for the leg pains are in almost every instance bilateral.

REFERENCES.

- [1] *British Medical Journal*, February 12, 1916.
- [2] *Lancet*, October 14, 1916.
- [3] *Lancet*, October 7, 1916.

Report.

INTERIM REPORT OF THE WAR OFFICE COMMITTEE FOR THE STUDY OF TRENCH FEVER.

TRANSMISSION EXPERIMENTS.

THE Committee was formed, with Surgeon-General Sir David Bruce as Chairman, in December last by the Director-General, Sir Alfred Keogh, acting on a suggestion received from France regarding the co-ordination of research on this most important subject.

The Committee at once set themselves to try to solve the problems of the causation and spread of the disease.

In view of the already widespread belief that the body louse was the guilty agent (unpublished experiment by Major A. C. H. Gray, R.A.M.C.; also Davies and Weldon, *Lancet*, February 3, 1917), steps were at once taken to feed lice bred from "clean stock" on trench fever patients of whom there were at the time many in the New End Section of the Hampstead Military Hospital under the charge of Major W. Byam, R.A.M.C., a member of the Committee who has supervised the clinical and experimental work.

The Committee were fortunate in having Mr. Bacot, of the Lister Institute, to control the supply and feeding of the lice.

Two volunteers, Messrs. Cole and Edgeler, came forward on January 3, 1918, for the purpose of the experiment from patriotic motives, as they were well over military age and not able to serve their country in more strenuous ways. Lice were taken from clean stock bred in this country. These lice were fed at intervals on many febrile and afebrile trench fever patients at all stages of the disease who had been sent over from France and had relapsed in this country. The lice were then placed on the volunteers, directly on the skin without any intervening gauze, the shortest interval between feeding on a case of trench fever and on the volunteer being six hours. After feeding they were returned to the box and kept in the incubator at 25° C., until again required. This experiment was commenced on January 5, and was continued daily for one month, at least 500 lice being used every day. The feeding experiment in one of the men was then discontinued, and although he has now been under observation for over two months he has showed no signs of fever.

The experiment was continued on the other man, but the conditions were altered: lice were fed on febrile cases of trench fever, and then after intervals of at one time fifteen minutes, at another of one hour and two hours, on the volunteer daily up to February 13, but again without any positive results as regards development of trench fever.

At the Committee meeting on January 28, Major Byam, in reply to a question, stated that these men did not scratch themselves, and indeed, purposely refrained from scratching, this excluding to a large extent infection by means of

excreta or crushed bodies of the lice; he therefore proposed that two more volunteers should be obtained and "scarification" experiments carried out.

On February 5, two men, Seymour and Sullivan, who also volunteered, were used for this purpose.

In the case of Sullivan, a small area of skin, one inch square, was lightly scarified and a small quantity of the dried excreta taken from the boxes of lice which had fed on trench fever cases was dusted on to this area and rubbed in.

On Seymour's arm, eleven lice, taken from a trench fever case, were crushed on the scarified area.

On February 14, Sullivan was suddenly attacked with typical trench fever after an incubation period of eight days. On February 16, Seymour also went down with fever, incubation period ten days.

This dramatic result was at once (February 19) reported to the Director-General, Army Medical Service, and also to the Medical Investigation Committee in France, with whom the Committee had been in close collaboration throughout, all minutes and results of experiments having been forwarded, and in addition, Lieutenant Peacock, R.A.M.C., who had assisted Mr. Bacot in the earlier work here, was loaned to the Medical Investigation Committee on January 24, to assist in the same work in France. The fever which these men developed was indistinguishable from that produced in other volunteers by an injection of whole blood from trench fever cases who had contracted their disease in France. In view of the importance of this discovery the Committee decided to repeat the same experiment.

Three other volunteers at once came forward, Messrs. Reynolds, Tullett, and Glover. These men were each inoculated on February 19, on a scarified spot on the forearm with a small quantity of dried excreta from boxes of lice fed on trench fever cases.

On February 26 Reynolds went down with trench fever; on February 27 Tullett was taken ill, and on February 28, Glover, the incubation periods being six, seven, and eight days respectively.

The chain of evidence was completed by the fact that a small quantity of blood taken from Reynolds on the second day of his fever and inoculated into volunteer Ward produced a typical attack of trench fever after an incubation period of five days.

The fever in every instance, although mild, was yet typical of the so-called trench fever—sudden onset; temperature of 103° F.; pain in the head and limbs, and over the spleen—the initial attack of fever lasting two or three days and followed in practically every case by a relapse or relapses at an interval of usually seven days, the fever in the relapse being lower and more transient, with a recurrence of the symptoms associated with the initial attack.

It will thus be seen from the above experiments that it has been shown that the bite alone of the infected louse does not produce trench fever, but that when the excreta taken from such lice was scratched into the skin, fever followed in every instance, the average incubation period being eight days.

This observation is of great importance in view of the prevention of the disease, and would explain cases of trench fever arising in wounded men who may have had no lice on them for some weeks, as the dried excreta if blown on to a raw surface would readily give rise to the disease. Some further experi-

ments carried out at Hampstead on the migration of lice are also of great interest; as it has been shown, that if two men be available, one with a normal temperature and the other with fever, the lice will leave the fever case and pass quickly to the man with the normal temperature. Experiments are now in progress with the excreta of normal lice, as it is possible that the disease is not necessarily carried from man to man by lice, but simply from louse to man.

In view of these results and their corroboration by the Medical Investigation Committee in France, it is hoped that a very determined campaign will be instituted against the louse, and thus eliminate, or at least reduce, the incidence of a fever which has up to now caused so great a drain on our man power at the front.

The fact that these experiments have been carried out in London is of the first importance, as there can be no suspicion of an accidental or natural infection, as the men employed had not been out of England for many years and had been under observation for some months previous to the experiments; also they were housed entirely apart from the hospitals in which the cases of trench fever were being cared for.

The funds for this research have been provided by the Lister Institute of Preventive Medicine.

Reviews.

STATISTICS *re* GONORRHŒA. By Major H. C. Donald, R.A.M.C. (T.) and Captain A. M. Davidson, R.A.M.C. (T.C.)

This is a companion volume to the graphic record reviewed above. In the introduction the authors draw attention to the seriousness of gonorrhœa, the necessity for more individual treatment than was possible in the large numbers of patients under their control, the limitations of treatment of the developed disease, and the high proportion of complications of all kinds (75 per cent). They conclude the introduction with a plea for a more determined effort to eradicate the disease by education and prevention. The remainder of the book is devoted to statistics relating to over 2,000 patients. It contains numerous points of interest, such as the incidence of complications, the effect on these on the duration in hospital, and a comparison of different forms of treatment. As to the latter, the criticism of the reviewer is that their value is considerably diminished by the fact that the different series were not under identical conditions, being treated at different periods of the year and under conditions which, to the knowledge of the reviewer, must have differed considerably in important details.

The book which, like its companion, is type-written and bound, has been placed in the Royal Army Medical Corps Library, with a number of bound volumes showing the progress, etc., of every patient included in the statistics.

L. W. H.

I.—THE PSYCHONEUROSES OF WAR. By G. Roussy and J. Lhermitte. English translation.

II.—HYSTERIA OR PITHIATISM AND REFLEX NERVOUS DISORDERS. By J. Babinski and J. Froment. English Translation.

These two volumes, dealing with the functional nervous disorders observed during the War, are complementary to each other and should be in the hands of all medical officers, who have soldiers suffering from "shell shock" under care and treatment. The reader must not expect to find in these volumes a complete account of the psychoneuroses or war hysteria, the object of the authors being rather to give clinical pictures of the various functional and reflex nervous conditions, which are observed both in the casualty clearing stations and in the base hospitals.

The volumes are written mainly with the object of instructing medical officers who have received no special training in methods not generally known, which will help them to recognize more readily the many manifestations of hysteria. The present War has afforded an exceptional opportunity for appreciating the rôle played in the genesis of this disorder by the emotions, concussion and local trauma. The number of soldiers suffering from hysterical disorders is considerable and many of them have been kept in hospitals for long periods under mistaken diagnosis or in receipt of unsuitable and entirely misplaced methods of treatment.

It is therefore very essential that the true nature of the psychoneuroses should be recognized as early as possible and that suitable treatment should be provided at the earliest practicable moment. The French Military Medical Service recognized this early in the war and established special centres for the treatment of these patients in the zones of the armies.

It is scarcely necessary to refer to the various clinical conditions graphically

described in the volumes under review. That upon the psychoneuroses deals briefly, in addition, with the difficult question of malingering and its relation to hysteria and gives a good account of the psychical conditions which may be regarded as hysterical. In the second volume Babinski describes in detail reflex nervous disorders, upon which the War has thrown much fresh light. Cases of atrophic paralysis and reflex contracture have been described for many years, but the War has called fresh attention to them, and in this volume the first full account of these important conditions is given to the medical profession. According to the authors they are very common and it is most important for every medical man to learn to diagnose them.

The volumes form part of a series of Military Medical Manuals translated from the French, under the general editorship of Sir Alfred Keogh. They are of convenient size and the letterpress is accompanied by a number of well-executed photographic illustrations.

W. A. T.

MILITARY MEDICAL MANUALS: TYPHOID FEVERS AND PARATYPHOID FEVERS. SYMPTOMOLOGY, ETIOLOGY, PROPHYLAXIS. By H. Vincent and L. Muratel, Translated and Edited by J. D. Rolleston, M.D. Published by University of London Press, 18, Warwick Square, London, E.C. Price 6s. net.

This little volume, as the authors state, gives a concise account of the progress made in the clinical, therapeutical and hygienic study of the enteric fevers, and should serve as an excellent guide for the medical man who, perhaps for the first time, is called upon to diagnose and treat such diseases.

A very great deal of valuable information is crowded into these pages. The first chapters treat of the clinical characters of typhoid fever in its ordinary form and also in the more obscure and unusual manifestations.

This is followed by a very complete description of the paratyphoid fevers in their clinical aspect, although it is not claimed that these fevers can be differentiated by any one symptom from true typhoid fever; this chapter contains in addition to original observations of the authors numerous quotations from a large number of different French observers.

It is unfortunate, however, that attacks of food poisoning due to *Bacillus enteritidis* and *B. aertrycke*, on the one hand are not more clearly differentiated from attacks of fever due to *B. paratyphosus* A and B on the other.

The same confusion is shown in the chapter on the etiology of the paratyphoid fevers where it is stated that the paratyphoid bacilli may "readily multiply in animals." Again, the contagious character of meat is explained by "what we have said with regard to the latency of the paratyphoid B bacillus in the pig's intestine."

In Chapter IV the diagnosis, both clinical and laboratory, is treated in a masterly manner, and the fact that the latter method is essential for a differential diagnosis is insisted on. In the description of the methods of isolating the infecting organism from the excreta, no mention is made, however, of the use of brilliant-green which has proved of much assistance in our laboratories, especially for the isolation of the paratyphoid bacilli.

Again, in the description of the Widal test it is stated that "normally human serum agglutinates the typhoid bacillus at 1 in 10 or 1 in 20 and the paratyphoid bacillus at 1 in 50 or 1 in 150." This is certainly not common in our experience. Also the statement "that the agglutinating power of inoculated men may be awakened into fresh activity by any disease of a non-typhoid nature" has not been confirmed to any extent by British workers, although the possibility has been recognized. Nor do we agree that "the results of agglutination tests are absolutely useless in those who have been inoculated." No mention is made of the method first introduced by Army bacteriologists, when

testing the Widal reaction in inoculated men, of carrying out a series of careful estimations by the macroscopic method; this method has undoubtedly been of the greatest assistance in the differentiation of fevers.

The chapter on treatment is full and complete, and also deals with diet and vaccine therapy.

In the chapter on etiology the "favouring" causes are discussed, such as climate, age, fatigue, etc., and the infectivity during the incubation period of the fever is insisted on. The rôle of the carrier is summed up thus: "In the Army the rôle of the carrier in peace time is certainly limited to a few special cases, but it becomes considerably more important in camps, and especially in war time."

Direct and indirect contagion are discussed, and the two schools of thought are reconciled and placed in their true perspective. The rôle of the fly is also considered, and although we may not all agree that the statement that "the typhoid bacillus lives in the intestines of flies, and they are true bacillus carriers" is scientifically correct, yet we can all agree that "flies act as a powerful and formidable intermediary and as a factor of contagion of the first rank."

The last chapter is devoted to a subject which is peculiarly M. Vincent's own, namely, prophylactic vaccination. A very full account is given here of the history of anti-typhoid inoculation in the various armies, and numerous figures and instances are quoted to show its undoubted efficacy. One very important point is made, and that is, that inoculations made on men who are fatigued will give rise to severe reactions, and rest both before and after inoculations is insisted on whenever possible.

The authors conclude by saying: "It cannot be doubted that as typhoid fever has shown itself very fatal in past wars, it would have been destined to play a preponderant rôle in the pathology of the present War if prophylactic measures, especially vaccination, had not been applied energetically, continuously, and conscientiously."

D. H.

Journal
of the
Royal Army Medical Corps.

Original Communications.

**A CLINICAL STUDY OF SOME FUNCTIONAL DISORDERS
OF THE HEART WHICH OCCUR IN SOLDIERS.¹**

By J. E. MacILWAINE, B.Sc., M.D., D.P.H.

Assistant Physician, Royal Victoria Hospital, Belfast.

Former Physician in St. John Ambulance Brigade Hospital, B.E.F.

THE subject which I propose to discuss in this contribution is one of the utmost difficulty; in fact, during the past two years it has always appeared to me to be the most involved problem I have ever met. At the outset, the title which I have chosen is open to serious objection on account of the term functional disorders. This is a vague and wide term, but in default of a better I have chosen it in preference to a still more indefinite classification which is in use in Army work, viz., D.A.H. (Disordered Action of the Heart). The reason for discarding D.A.H. as a description of any clinical condition is, that practical experience has shown me this pseudo-diagnosis can be so stretched as to include almost any medical ailment. In two previous papers I endeavoured, with the help of my colleagues, to deal with the practical side of the question of cardiac disorders occurring in soldiers on active service; and in these articles we subscribed to the diagnoses V.D.H. and D.A.H. We used these terms with a full recognition of their value when employed under active service conditions. On active service the question most constantly before the M.O. is that of "fitness" or "unfitness" of the soldier for duty. If the decision is that the man is unfit then refinement of diagnosis is often out of the question. The problem differs when the men are examined at a base overseas, as the question to be decided under these circumstances is in another category. At a base a prognosis has to be formed as to the soldier's prospect of returning to duty, and an estimate made of the

¹ Paper read before Ulster Medical Society, December 6, 1917.

probable duration of the treatment he will require to render him fit. Our experience in dealing with over 3,000 cardiac cases at a base overseas taught us that a single thorough clinical examination of a soldier suffering from cardiac symptoms enabled us to make a more accurate diagnosis of the condition present; and to form a prognosis of his prospect of future fitness. In figures, an accurate diagnosis enabled us to dispose immediately of roughly one-third of the above 3,000 men. The remaining two-thirds of these cardiac cases are those I wish to consider to-night, and I have used the term functional in connexion with their description, because clinical examination failed to detect any organic disease which could be considered definitely responsible for the evident cardiac symptoms and signs present.

The clinician is placed in a position of great difficulty in dealing with these cases when he is asked to express an opinion as to the man's disposal after one examination; indeed, an opinion so expressed is often of very little value. To answer this question of disposal of the soldier, to active service, for duty at the base, or for evacuation to England, it was necessary to use what has been described as an "effort test." This "effort test" was made by submitting these doubtful cases to a course of graduated physical drill which extended over six weeks. The men were able to report sick any day they wished, and be re-examined if necessary. At the end of three weeks each man was re-examined clinically and disposed of, or told to continue the course. On the termination of the six weeks a final examination was made, popularly known amongst the men as "a strafe," and as just a decision as could be formed from an estimation of the man's condition decided his fate, "Active" or "Base"! By this practical method of treatment, roughly one-half of the number of men so treated were classified as fit to undertake another period of active service, whilst the majority of the remaining half were categorized for suitable work at the base. A few of the men developed, during their course of treatment, some conditions which rendered their disposal by evacuation to England advisable. It must be remarked, however, that although the only question of practical importance to an army in the field had been answered, the riddle as to the pathological cause of the men's incapacity had not been solved. Thus, whilst we had evolved an apparently efficient scheme for dealing with the D.A.H. problem at a base overseas, I still felt we were defeated by the question from a scientific medical point of view. This scheme, which congregated together a lot of men complaining of cardiac symptoms associated with a neurasthenic state, was not free from adverse criticism from an army medical point of view. I did not feel that I was capable of judging of its exact value to the military authorities, but it was evolved as a natural sequence of events in the investigation I had been given the opportunity to carry out. For this opportunity I have to thank Colonel H. Carr, C.B., the D.D.M.S. of the administrative area in which we worked, and to Major H. B. Dennis, R.A.M.C., the

A.I.D. (Assistant Inspector of Drafts), I am grateful for instruction in what to me was a new branch of practical medicine. I am, perhaps, most indebted to Surgeon-General C. Burtchaell, C.B., for his interest in this work, for the information he gave me on the subject, and for the opportunity of seeing a portion of the vast work that is being done by the Royal Army Medical Corps outside the hospitals. After seeing this work, I realized how much the existence of an army depends upon the medical man who is also a soldier. The civilian doctor engages in peace times in a practice of medicine in which the individual patient is the most important consideration, whilst the Army doctor, in war time, realizes that the keeping of an army in being is the chief consideration, and that an individual point of view is not possible. It was through considerations of this sort that I learned that the D.A.H. problem has another aspect to the purely medical one which first arrested my attention. On fuller consideration, I began to realize how great was the weight which the War has thrown upon the medical profession by this single question of fitness or unfitness of the individual soldier. To-day the medical officers decide *per diem* thousands of cases which in civil life would occupy the law courts for weeks. Unfortunately many of the cases so decided are not finished with by these decisions. The Army often discards the soldier, and the problem has to be really tackled in civil life. The medical profession stands in a position of trust to the State and to the individual, which is indeed an onerous one. I think this trusteeship is rather comparable to the duties such a position always carries, namely, responsibility, often disapproval of those whom the trust concerns, and inadequate recognition of service rendered.

Throughout the whole experience gained during the two years' work abroad the clinical aspect of this subject, "soldiers' heart," dominated my thoughts. The question of dealing with these men in the Army seemed simple compared with the problem of their return to civil life. I constantly felt that any light we could obtain upon the clinical side of these so-called functional conditions would be an invaluable assistance in dealing with their treatment at home. One of the most striking features of the present War is the partial aspect of many of the clinical observations made. This is due, of course, to the existence of a different atmosphere and different circumstances, according to the place where the clinical observations are made. Thus, up just behind the firing line, in a field ambulance, the clinical pictures in the same men may differ from the clinical pictures at a base hospital overseas. No doubt the clinical condition of the patient is in many cases changed by his safe arrival in Blighty. I mention this, because all the facts I have noted are the result of the work at a base overseas.

The term functional disorder denotes an absence of any known pathological basis for the condition which was so ably described by Da Costa as "Irritable Heart" [1], and Sir James Mackenzie in his paper, "Soldier's

Heart." [2]. In spite of the most searching investigations during the past three years for some definite finding to explain the pathology of this incapacitating syndrome, we are still without exact knowledge as to its cause. If one desires a clinical description of the condition, it is hard to improve upon that of Da Costa. On the other hand, if an analysis of the symptoms, and the study of their possible pathological basis is sought after, the Report of the Medical Research Committee of the work of the Military Hospital at Hampstead supplies the latest scientific information on the subject. Before entering upon deductions from the results of my own clinical observations, I will give a description of the incapacity from which the soldier suffers. The picture varies, but the fundamental factor is, the soldier fails to endure a moderate amount of effort without collapse or fainting; and may be unable to resist exhibiting similar symptoms when under stress of even moderate emotion. The usual history is somewhat like the following: "I am alright if I go slow, but if I have to try to march with the pack after I have gone, say half a mile, or on the first hill, I begin to feel my heart thumping. Then I get a stabbing pain at the heart, I have a choking sensation in the throat, my eyes get mazy, I feel dizzy, and if I go on I stagger, and then I fall." The man will then say he gets the same syndrome on attempting to double, and sometimes volunteers that he has a similar experience on putting on his gas helmet. The history is the same in substance; but the description of the man varies as to the principal or prominent feature, i.e., pain, dyspnoea, palpitation, vertigo, weakness, fainting, exhaustion, etc. The soldier also often complains of the same symptoms occurring just as he is going to sleep, or his waking with the pain and palpitation and choking sensation. Many other facts connected with this syndrome become evident through the histories of the patients, and an interesting one is how often these men have carried on in spite of their symptoms. It was a common enough story of the man that he managed for months to get in and out of the trenches by taking his own time, and resting on the way up. Another point of interest in the symptomatology was that, if the man did fall out on a hill, often a short rest enabled him to follow on and finish the march. I did not usually have the opportunity to see these men in the fainting condition, but have seen some when they have been lying after falling out, and the feature was, the good colour of the man, with the hurried respiration, profuse sweating, and tachycardia.

In giving the above clinical picture, I have done so instead of trying to define the functional disorder. The condition is so easy to recognize from the symptoms, and the marked tachycardia on emotion or effort, that the most one can do by clinical examination is to find if there is associated with the syndrome any organic disease. The results of the notes taken in careful clinical examination of our first 1,200 cases form the basis of the following remarks. The history of the man was gone into as fully as time permitted, and we followed any clue we could obtain as to previous

infection, trauma, capability during army training, capability during active service, previous rejection as a recruit, etc. In the clinical examination the signs of any organic disease were looked for, and the condition of the teeth and tonsils noted in each man. I may say that all the men were considered as possible subjects of hyperthyroidism unless that possibility was unsupported by the examination. All efforts were directed to determine whether there was any organic heart disease present, endocardial or myocardial. At one period of this work Major Houston made a bacteriological examination of the urine of 100 of these functional cases, and no abnormal condition presented itself. The clinical examinations brought out in many cases the fact that the syndrome was associated with definite organic changes in the respiratory or cardio-vascular systems, in a few cases with Graves's disease, and in some cases that the man was still suffering from a pyrexia of uncertain origin. At the very outset of the investigation I was struck by the condition of the nervous system as exhibited by the state of the reflexes. If one translated it into figures, two-thirds of these men might simply be described as cardiac neurasthenics. I resisted the substitution of neurasthenia as a diagnosis in these men, because it appeared to be of no definite aid in explaining this syndrome; but I felt strongly that this associated neurasthenic state had to be considered an important factor in forming a prognosis as to the probability of recovery of these men fit for active service. After seeing many hundreds of these patients while they were under treatment by graduated exercise, my constant feeling present was one of depression, on account of the evident neurotic element in many of the men. To put it bluntly, their psychological condition was anything but that of a soldier, and this in spite of the fact, if their history was to be credited, that many of them had "stuck it" for months in the trenches. Finally, when now finished with the practical side of the question, I have looked over the notes we have taken, and consider that this group of functional cardiac disorders can be included under the diagnosis neurasthenia. The following theoretical conceptions are brought forward to support this view.

I think to-day that we have reached a point in clinical medicine when it becomes necessary to recognize more fully the functions of the involuntary nervous system. I have endeavoured to make it clear that in a very large proportion of these men who are suffering from this "irritable heart condition," there is a psychological element and an associated neurasthenic state. There is a removal of the ordinary inhibition which prevents a man letting it be obvious that he is not going "up the line" if he can avoid it, and the man persists often, in spite of our contradiction, that he is a "heart case," and is not able to refrain from producing evidence to this effect. Sometimes, on the other hand, the man insists, in spite of an incapacity which is obvious to himself, on trying to return to duty. This want of mental control, and the frequent story of feeling all right one day, and "rotten" the next, may be taken as evidence of a lowered threshold

of psychological stimulation. This same diminution of inhibition is seen in the increased excitability of the deep reflexes, often of the superficial reflexes also. In other words, we observe the reaction of the man to mental and mechanical stimuli is excessive.

It is only necessary for me to indicate the main features of the involuntary neuro-muscular mechanism in order that we may see that it is a reflex system in the widest sense of the term. It is not possible to go into detailed description of this regulating mechanism; but let me remind you of some of the operations which it controls.

(1) The regional distribution of the blood supply, and the reflex maintenance of the body temperature through proper distribution of the circulating fluid. This fact must be borne in mind in the soldier, where the strenuous exertion and heat production are excessive, especially if he is carrying full equipment. Perhaps it is not out of the way to point out how great a part the secretion of sweat must play in this heat loss; and how excessive heat production means more CO_2 to be eliminated. Dyspnoea and sweating are the involuntary result of normal exertion, and we might say a normal reflex.

(2) The reflex movements of the whole alimentary system from the oesophagus to the anus.

(3) The regulation of the blood supply in such a manner as to counteract the effects of the force of gravity, sudden postural change, etc. This is an exceedingly complex proposition from a mechanical point of view.

(4) Many of the reflexes which appear as the result of emotional disturbance come within the province of this involuntary mechanism.

(5) The mechanism of the organs of reproduction.

All these considerations appealed to me when thinking of the tax of active service upon the nervous mechanism of the body. A closer study of the involuntary nervous system as elaborated by Gaskell [3] allowed me to see even a more detailed reason for the view, that a neurasthenic state was evidenced by the lowered threshold of reflex excitability in the cardiovascular, the respiratory, and the alimentary systems. The question of the reflex effects of emotion through this involuntary system is as old as the time when the heart was considered to be the seat of the emotions. Clinical medicine is bound to embody much more the consideration of the work of the physiologists in this field, and to-day the study of the results obtained in their investigation of the involuntary nervous system illuminates many conditions we have called neuroses. If the description of Gaskell be followed, we learn to recognize three main parts of the involuntary nervous system.

(1) The cranial portion, mainly composed of fibres in the vagus, which carry involuntary impulses to the heart, lungs, stomach and small intestine. (Cranial outflow.)

(2) The thoracico-lumbar portion (the sympathetic nervous system), which is the path of nervous supply to the heart, the blood-vessels all

over the body, the sphincter system of the intestines and the bladder, the involuntary muscles of the skin connected with the hairs and the sweat glands, etc.

(3) The pelvic portion, which is mainly concerned with the involuntary impulses going to the large intestine, bladder, and the organs of generation.

I do not intend to elaborate the details of this reflex mechanism further, but it is necessary to mention the close association of the part called the thoracico-lumbar portion with the function of the adrenals. Physiologists have shown that the secretion of these glands, i.e., adrenalin, when injected into the circulation of an animal, produces the same effect as stimulation of this nervous mechanism. No such effect is produced on the vagal or pelvic portions by this secretion. It may not be out of place to note at this point the work of Cannon, which demonstrated that in animals subjected to severe emotional stress, there was a definite increase of the amount of adrenalin found in the circulation. The difficult fact to grasp is, that an emotional state must now be associated with a definite physical change in the body, which change includes an increased amount of adrenal secretions in the blood correlated with a stimulation of the involuntary nervous system. These views of Gaskell may or may not stand completely, but I think any clinician reading them will find a new light on symptomatology of disease. The knowledge of the intricate reflex mechanism of the body, which is beyond our control, will aid in the solution of the problem which so-called functional disorders present. Let me say, in concluding this introduction to the consideration of etiology and symptoms of "irritable heart," that the term involuntary indicates sufficiently that these reflexes cannot be called forth at will by the individual. There are some people who can increase the frequency of the pulse voluntarily, but they are most exceptionally gifted. I have never heard of any person who could voluntarily produce a condition of "goose-skin"—a pilo-motor reflex—or by volition produce sweating, or develop cyanosis of the extremities, etc., or exhibit a blood pressure 20 to 30 mm. Hg above the ordinary pressure for the individual.

The exaltation of these involuntary reflexes is as indicative of a condition of alteration in the nervous mechanism of the body as any other evidence we can produce, and that they are involuntary enhances their value as evidence where the question of simulation arises.

ETIOLOGY.

In the endeavour to discover the etiological factors which bring about the symptom complex of cardiac irritability, as outlined in the opening description of the paper, I take the view that the condition is the result of a state of "irritable weakness" of the involuntary neuro-muscular mechanism in association with a similar state of psycho-motor and psychic systems. In one word neurasthenia.

This view at once adds to the difficulty of the D.A.H. problem from

many aspects. The discussion of the etiology of neurasthenia is a subject beyond the scope of this paper; but I consider these remarks, made as the result of the examination and treatment of men in whom the neurasthenic symptoms were most evident in the involuntary neuro-muscular system, are applicable to the general condition, neurasthenia. The object I have in view is to present a picture of a neurasthenic state in which the psychic and psycho-motor disturbances may be overshadowed by the evident changes in the involuntary mechanisms of the body, and to put forward the points which seem to throw any light on the genesis of the condition.

EMOTION.

Under this head a full discussion of psychic influences upon the body would involve a study of modern psychological conceptions, details of which are not all of practical value in clinical medicine. It will be sufficient for my purpose to repeat again, as an example of influence of mind upon body, the excessive secretion of the adrenals as a demonstrated fact in animals suffering from stress of emotion; or to mention Crile's elaborate technique to minimize the effect of psychic shock during a surgical operation. The stimulus of emotion can hardly ever be absent in health, but in civil life it can be reduced to a minimum. Even with such a reduction, everyday life shows us examples of how differently different individuals react to small stimuli. Take as a contrast the conditions of active service in modern warfare, and it is not difficult to imagine the enormous emotional stimuli which occur; nor is it difficult to foresee the results. The marvel is that the human organism, from a nervous point of view, has resisted this stress as it has done. We are apt to forget that the soldier's profession is, perhaps, the oldest in existence, and that discipline is the weapon which has been forged to combat the effect of these emotional stimuli. The Army is a school of practical psychology. This is very evident when one sees how the soldier is formed from the recruit. The exact point at which the result of an emotional stimulus is to be considered as a pathological effect is impossible of definition; and as a consequence it is hard to state what exactly constitutes a pathological reaction in the involuntary neuro-muscular mechanism. A further difficulty is encountered if we are asked to say whether this low threshold of stimulation is the normal, healthy reaction of the individual, or whether increased emotional response is evidence of a diseased state of the nervous mechanism. It is not necessary to discuss this all-pervading factor of life more fully; sufficient has been said to show how much the psychic element enters into the stress of the soldier's life on active service, and the old physiological law—the summation of stimuli producing a maximum response—has a chance of operating on the healthy or poisoned nervous system. Many writers upon the subject of nervous shock have pointed out the condition which can arise from simply a definite psychic shock, therefore it is to be remembered, when considering the effect of shell explosion producing concussion with uncon-

sciousness, that there must be a large concomitant psychic shock of which there is no conscious memory. When dealing with the question of treatment of these functional disorders, it will be necessary to return to some of these considerations.

INFECTION.

To enter into this question is to commence a discussion on what my colleague, Major Houston, describes as the greatest problem that clinical medicine has to solve. By this I wish to indicate the difficulty in establishing a proof that an intoxication of the body is arising from a septic focus which we can detect, or which we may suspect exists.

It is a definite fact that we are as yet unable to bring forward any direct evidence that the functional condition "Irritable Heart" is due to a chronic infection, but I will endeavour to state my reasons for considering bacterial toxins as a possible basal factor of the syndrome. The evidence of the history of these men; in a very large number of instances the symptoms occur for the first time during or in convalescence from an infective disease. Similar signs and symptoms may occur in any patient after infection on attempting to return to the normal use of the reflex mechanisms of the body. These symptoms, however, pass off readily in the majority of people. What, therefore, does their persistence in certain individuals mean? Is it the persistence of the toxic effects, or merely the question of a weakened nervous mechanism? These queries cannot be answered in the light of our knowledge to-day, but it is most suggestive that we know of a definite injury to the nervous system—post-infective neuritis—which we attribute to the action of the bacterial toxins in circulation during the infective stage. The possible effect of these toxins on the finest elements of the nervous system, the dendrites and their synapse mechanism, is an alluring assumption in the light of nervous integration.

The next comparative consideration is the incidence of rheumatic infection in connexion with these cardiac disorders. Many points are of interest when reviewed from the standpoint of the cardiac pathology of to-day. Mackenzie's conception of the life-long infectivity of rheumatic virus, with its exacerbations and gradual destruction of the cardiac efficiency, may be well worthy of consideration as a prototype of many chronic infective conditions, against which the body is only able to establish a temporary immunity. It has not been customary to associate functional cardiac disease with rheumatic infection; but in these so-called functional disturbances which are under discussion, a very fair proportion of the men have previously suffered from an attack of rheumatic fever. I do not think that we can neglect the nervous element which is here associated with the possible chronic intoxication of the rheumatic infection. It is of interest to consider also the close connexion which exists between chorea with its nervous symptoms, and rheumatic fever; as in chorea we

have exhibited a distinct disturbance of the psycho-motor and psychic mechanism. It is possible to develop this line of thought still further if we argue that tonsillitis is often found to be associated with irritable heart; here again clinical evidence is strongly in favour of our infective agent being closely related to the rheumatic virus, and neuritis may be associated with tonsillitis.

It must be remembered that the most careful examination of all these patients revealed no evidence whatever of the presence of any organic heart disease, myocardial, or endocardial; hence it appears necessary to seek some other source of circulatory inefficiency than the heart. On general grounds it may be said we appreciate fully the neurasthenic state of the psycho-motor and psychic systems which arise so constantly as a sequel to an infection; and that it is not a huge assumption to take it that the involuntary neuro-muscular mechanism is likely to be found in a similar state.

TRAUMA.

Many of the men gave a history, dating the onset of their symptoms from shock associated with a shell explosion, or following recovery from a wound. Here, of course, the first two factors above may be in operation, i.e., emotional shock and infection. It is well known that the sensations which immediately precede unconsciousness are completely forgotten; but it is hard, when we consider the rapidity of thought, to believe there is not an enormous psychic stimulation before this temporary dissolution. Clinically, the picture of the soldier, in whom the diagnosis of traumatic neurasthenia is as correct as that of "Irritable Heart," resembles very closely some of the cases seen in civil practice after accidents.

GASSING.

This may also be considered in the light of psychio shock, or as post infective, since the second stage of the lung condition in these men was undoubtedly an added infection to the primary destruction of the lung tissue.

HYPERTHYROIDISM.

The possibility of a condition of hyperthyroidism was carefully considered, but the evidence was quite inconclusive, in spite of the fact that the soldier on active service is apt to develop an enlarged thyroid. If an argument of the legal type may be used one might say, even if it is due to hyperthyroidism, the latest work of M'Carrison would associate Graves's disease with toxic absorption as the primary cause.

Before leaving this question of etiology, there are many points which will bear mentioning. As already pointed out, in about a third of the men who suffer from this incapacity, we can demonstrate some organic disease which we are accustomed to associate with the idea of toxic absorption. Then again, it was remarkable in a considerable number of these men,

to note the evidence of past disease and possibly severe intoxication which their deformed chests afforded.

The question of the possibility of these men "doping" themselves must always be considered; but I feel satisfied that this is a very rare occurrence, and any of the vaso-dilator group, such as the nitrites, would produce a different clinical picture. Then the constant association of tobacco with cardiac derangements in civil life naturally makes one think of it as an etiological factor. That it accentuates the symptoms is evident [4], but that it is not the cause of the condition is certain by the quite moderate number of non-smokers who are afflicted by this incapacity. It is very often asserted that the condition is due to aberrant sexual conditions; but here again there is no direct evidence, and if such conditions are present I should think they are associated in some way with the pelvic portion of the involuntary neuro-muscular mechanism, and a symptom of a lowered threshold stimulus, rather than a cause of the syndrome.

To sum up these considerations of the possible etiological factors involved in the functional disorders described under the terms "Irritable Heart," "Soldier's Heart," "Cardiac Irritability," etc., it might be said that this syndrome is evidence of a lowered threshold of stimulation in the involuntary neuro-muscular mechanism. In discussing the origin of this lowered threshold of stimulation, two factors, emotion and intoxication, seem to be the agents at work. Add to this the consideration that each individual has in all probability a response characteristic for himself to these two factors; and so, as it were, is in his normal condition placed close to, or far from, the boundary that separates a healthy state from neurasthenia. Thus, an exaggerated emotional disposition, an intolerance of a specific toxin, or any toxic effect, may be the basis of the irritable weakness of the nervous system which we call neurasthenia. The idea that a stimulus constantly repeated may, under apparently healthy conditions, break down the mechanism opposed to it, can be used also to assist in the explanation of the origin of this debilitated state of the psychic, the psycho-motor, and the involuntary nervous mechanism of the neurasthenic soldier.

SYMPTOMS AND SIGNS.

I have very little to add to the clinical description of the symptoms and signs which are associated with this "irritable heart condition," and which have been so fully set out in the works cited above. I shall rather endeavour to associate these clinical observations with a disordered action of the involuntary neuro-muscular mechanism.

PAIN.

The patients' description of this common symptom is very varied; thus the sensation complained of may be—a stabbing pain, a pain like the sticking of a needle, a bursting feeling, true anginoid pain, crushing, etc.,

with extension of the sensation of pain down the left arm. These præcordial sensations are often associated with hyperalgia of the left side of the thorax. In many men we noted a tenderness on moderate pressure in the fifth or sixth left intercostal spaces, extending from the axilla to the sternum, i.e., below the heart, and segmentally not an area to which true cardiac pain is usually referred.

We do not know the exact condition of heart and blood vessels at the moment of an attack of true angina, but we do know that emotion and effort are often the cause of its onset. Further evidence of associated strain in the involuntary neuro-muscular mechanism may be adduced from the fact that sudden exposure to cold may be the cause of onset of "breast pang"; also we know how intimate is the connexion of many attacks with a distended atonic condition of the alimentary canal. It has been usual to consider that this true anginal pain is most probably associated with coronary sclerosis, and during the attacks a relative ischæmia of the cardiac muscle. It is interesting to note that in these young men, with an apparently healthy myocardium, who suffer from cardiac pain, this pain is associated with an over-action of sympathetic portion of the involuntary nervous system. This over-action is expressed as excessive tone of the cardiac muscle, and it has often struck me that as a descriptive term "cardiac colic" would convey a theoretical explanation of the associated pain, and, perhaps, rob the man of some of the distressing emotions it causes.

PALPITATION.

The soldier generally characterizes this as a throbbing, and refers it to the præcordia, or often speaks of it as in the neck or head. A rapid beating or fluttering is the usual description, but it is quite a common statement that at times the heart seems to get gradually slower and slower, as if it would stop. The sensation of the extra-systole, the feeling of heart stumbling or turning over has been often described. In a very few instances the attack was of the type of paroxysmal tachycardia, but, as a rule, there was simply an acceleration of the pulse frequency by a shortening of the diastolic period of the cardiac cycle as shown in the electro-cardiograms. These cardiac sensations are of great interest, as in the normal individual the sympathetic acceleration or vagal slowing passes unnoticed, or, if noticed, is easily accounted for by the circumstances which produce it.

DYSPNOEA.

This symptom is, perhaps, the one which the man most often states is his principal disability on exertion. It is better described as a sensation of dyspnoea. Many speak of it as a choking or a catching in the throat, with a feeling of the impossibility to get a breath. When seen in this condition, the usual appearance is of a man who is breathing rapidly with small respiratory excursion of the thorax, and no degree of cyanosis to warrant the assumption that there is any deficiency of oxygenation present. I had

one man who developed this dyspnoea with syncopal feelings while he was being cardiographed, and there developed coincidentally an acute emphysematous condition of the lungs with asthmatic wheezing all over the chest. The general attack was similar to the ordinary hysterical faint so commonly seen in hospital externs in young women. The cardiogram simply showed an ordinary tachycardia. There was profuse sweating, the pupils were dilated, and the whole condition passed off rapidly on a severe admonition. Undoubtedly some of the men who arrived carrying full equipment showed on arrival an emphysematous condition of the lungs, which passed off rapidly. By this I mean there was evident temporary distension of the lung, as on forced expiration, i.e., coughing, the areas of cardiac and hepatic dullness being diminished. This slight distension passed off while the patient waited, say in half an hour.

The most interesting work which has been done in connexion with this question of dyspnoea has been carried out by Lewis, Barcroft, and others, assisted by Professor T. H. Milroy. The members of this Society appreciate the work of Professor Milroy through the papers he has read before it; these contributions have made us familiar with the electro-metric method of estimating minute variations in the reactions of the blood reckoned in free hydrogen ion concentration, i.e., absolute acidity. We had learnt to recognize the fact that the respiratory stimulus for increased breathing action was accompanied by an increased absolute acidity of the blood due to the increased CO_2 in the blood; this increased free hydrogen ion concentration being the probable stimulus to the nerve cells in the respiratory nerve centre. To put this in a simple way, we might say that the normal result of effort produces a slight acidosis (a relative reduction of blood alkalinity) which is the stimulus for the increased respiratory effort. The result of this work on "soldier's heart" was of extraordinary interest. It appears, that owing to a diminution of reserve alkali, the blood of these men, who show a dyspnoea out of proportion to the effort exerted, is acidified more easily by the action of CO_2 than the blood of a normal person. The fact that the blood of these men who exhibit a general instability of the nervous system, i.e., neurasthenia, should show an instability to an acid intoxication of normal amount of CO_2 , and a correlated increased respiratory response to effort is most suggestive. The work at the Military Hospital, Hampstead, would go to prove there is an excessive change of the blood reaction to the normal amount of CO_2 which effort produces, i.e., we have a physical basis for the excessive nervous reaction in the respiratory system, in other words, a chemical explanation of the intolerance of the neurasthenic to the normal acid intoxication which effort produces.

VERTIGO.

This is a very common symptom, and is probably associated with defective action of the cerebral blood supply and the semicircular canal mechanism. The careful study of this sensation did not elicit any very

conclusive opinions as to its causation, but it often appeared to be closely related to the type of giddiness which we are inclined to regard as reflexly connected with the alimentary canal.

FAINTING.

I have only seen one true faint, and that was seen while the patient, a non-commissioned officer, was actually being cardiographed. The cardiogram showed an increasing bradycardia, with disappearance of the auricular complex—a typical vagal overaction. I saw several faints in which the man had not lost consciousness, and which were similar to the ordinary hysterical fainting fit. No doubt the condition of the abdominal musculature of many of these men was such as would readily allow of the faint being accompanied by the lagging of blood in the abdominal cavity, and I was struck with the fact of the great abdominal support the kilt afforded when considering this possible cause of fainting. On final consideration I was disposed to think that this abdominal distension, so common in these men, was simply an expression of the general want of muscular tone rather than the cause of any of their symptoms.

SWEATING.

This was a remarkable feature in some men, and most of them complained of excessive sweating on exertion. On a cold morning I saw one man's hands which were blue and cyanosed, simply steaming, which showed in his case the secretion of sweat was not associated with vascular dilatation. The secretion of sweat would seem to me to be the overaction of a portion of the involuntary mechanism which regulates the heat loss.

SENSATION OF EXHAUSTION.

This is so common as to be almost a source of amusement to those who have to deal with these men. The constant vigilance required to keep them out of bed is a demand upon the temper of the sisters and orderlies. The picture of a healthy, strong-looking man who takes to his bed on the very least provocation is very apt to excite derision and contempt amongst those attending upon wounded soldiers; but the "heart case" is often oblivious to these surroundings, the sensation of exhaustion dominates him.

Insomnia is often present in these patients, but if one were to rely on impressions, the men complained much more of this when we had them in hospital than when they were treated as routine convalescent camp patients. Undoubtedly quite a number of these men suffered from headache, but it did not give one the impression of being of an excessively severe type.

Many other symptoms would bear close analysis, but they are not of the relatively simple type which have been discussed above. I would, however, remark that they are very common complaints of everyday life,

and that the general practitioner recognizes their association with what he often calls a nervous breakdown.

SIGNS.

It has already been remarked that almost all that can be accomplished by a clinical examination in these cases is to note the absence of any organic disease. The many signs of circulatory disturbance may now be discussed, and I think it is again advisable to remember that the heart is only a portion of the circulatory system. At the risk of being perhaps too elementary, I will remind you that the heart is the pump, but the arterial system is a reservoir of variable capacity, and in which the pressure is dependent not only upon the force of the heart muscle, but also on the condition of the arterioles, i.e., the diminished size of the arterial reservoir is usually associated with a rise of pressure. In the healthy state the circulation is maintained by correct balancing of force of heart muscle, size of the arterial reservoir, and pressure in this reservoir. This balancing is accomplished by the involuntary nervous mechanism through the apparently opposing actions of the vagus (the cranial outflow) and the accelerator sympathetic (the thoracico-lumbar outflow). The efficiency of the circulatory apparatus, therefore, depends upon correct co-ordination of these involuntary nervous impulses, just as all our voluntary muscular actions depend on the proper co-ordination of the voluntary nervous impulses to opposing muscles. In the following description of the signs of circulatory disturbance, I shall endeavour to keep constantly before your minds the view that a failure of circulation may be simply a failure of nervous co-ordination, and not necessarily an incompetence of the heart muscle. The immense importance of this nervous element in circulatory failure was not clear to me in the earlier part of my investigations, and I was very disappointed to find that the electro-cardiograph apparently would throw no light on the problem, as all the myocardial records pointed to a normal, healthy type of muscular contraction. It was only after seeing many of these hearts by means of X-ray examination to be of normal size, or often slightly smaller than normal, that I finally concluded that the clinical evidence of the presence of a normal heart muscle was overwhelming.

.TACHYCARDIA.

The most obvious sign, as a rule, is tachycardia, and one could, of course, spend endless time on the description of this marked feature of the syndrome. The main points of interest are, that the increased pulse rate is very evident in response to emotion or effort. The change of rate which accompanies the change of posture is to my mind a most important reflex of the involuntary mechanism. I cannot think that emotion plays much part in this reflex, where the pulse shows a persistent tachycardia as a result of change from the recumbent to the standing position. In all the men we examined we took the pulse-rate at the end of a standard

amount of exertion, and after a two minutes' rest. I did not feel, however, that there was any certainty of excluding the effect of emotion reflexly elevating the pulse rate. In all the men so examined, it was very evident the man considered our decision was a very fateful one for him, as it involved his return "up the line" or a sojourn at the base. I have seen many instances of this decision settling the pulse irrespective of whether it was favourable to the man's hopes or not. Some few men suffer from attacks of paroxysmal tachycardia, but I was only able to prove its existence in two cases, although 3,000 cardiograms were taken.

THE HEART.

In many of these men, the moment they strip the excitability of the heart is obvious on simple inspection. There is seen a flashing wavelike contraction running from the left side of the sternum over the præcordia, and there is often epigastric and carotid pulsation. The man may be holding the thorax close to the expiratory position, and the broad impulse or cardiac wave disappears on deep inspiration. This is easily seen on the X-ray screen to be associated with a considerable diaphragmatic movement. On palpation the impulse is more jerky and forcible than heaving. It is very extraordinary how great the difficulty is of locating the left margin of the heart in many of these men. It was surprising how often, where we thought the heart was enlarged, the screen examination showed the heart to be of normal size, in some cases slightly smaller than normal, while in others the heart showed a very marked change of shape with the phases of respiration. I cannot pass without remarking again upon this apparent enlargement of the heart, and the observed fact that it may be smaller than normal. This slight diminution of size I would consider as evidence of an increased thoracico-lumbar affect associated with the increased vascular tone. I have undoubtedly seen some men in whom there was a slight cardiac dilatation, but there was, as a rule, some slight febrile state associated with the cardiac distension. I cannot help thinking that in many cases the extent of the visible pulsation leads to the diagnosis of acute dilatation, when the heart is even smaller than normal, and the pulsation is simply a conducted one, such as is often seen in a person with irritable aorta. Determination of the size of the heart by percussion in many of these men is also difficult, as the tactile sense is disturbed by the pulsation. In endeavouring to limit this error as much as possible, I found ortho-percussion of the most service. It is with these facts in view that I feel the greatest care must be taken before the statement is made that any of these patients suffer from even temporary dilatation. The next consideration is that of the auscultation signs. These are very varied, but one of the most common changes is a peculiar loud first sound at the apex. There are systolic murmurs of innumerable types to be heard in these hearts. They are indeed varied, and in the same heart the murmur comes and goes in an inexplicable manner. I used often to compare these

murmurs to the physical signs heard over a tubercular focus in the lungs, both seemed to vary so much from week to week. It has occasionally been my experience to send a man into hospital, thinking that he had mitral reflux, and the following day in hospital consider the heart was normal. The whole examination of the cardiac condition of these men seems surrounded by pitfalls. I think it is to be best attacked by taking into account the question of the cardiac tone as maintained by the balanced action of the vagus and thoracico-lumbar portions of the involuntary nervous system. The heart is not a fixed size, and its size can be increased by stimulation of the vagus. I do not know of any experimental evidence of the diminished size through sympathetic stimulation, but it is diminished in normal men after severe exertion. In practically every one of these men the cardiogram was of a normal type. There was no evidences of left ventricular preponderance, on the other hand the "R" wave was often prominent in Lead III, while the "T" wave in this same lead was equally often inverted.

VASO-MOTOR.

The blood pressure is usually somewhat above the normal, often between 140 and 160 mm. Hg systolic, and 80 and 90 mm. Hg diastolic in many cases. The radial artery wall was, as a rule, so distinctly palpable as to be considered in a condition of increased muscular contraction. The hands were often markedly cyanosed, and even the condition of "dead fingers" was a common complaint. There was often a marked "tache cérébrale," and in one or two men wheals could be produced by simply sharply stroking the skin with a pencil, or slight nipping had the same effect. This, I take it, is merely evidence of vaso-motor instability.

THE LUNGS.

A considerable number of these men were quite unable voluntarily to breathe deeply. This is very commonly noted in the civilian, but it appeared in these men to be a decided handicap. The chest was often held in the expiratory position, and although the expansion was normal, the man usually breathed with a very shallow excursion. Quite a number of these functional cases had deformed chests of various types. I felt that the deficient respiration was in many cases as much a part of their incapacity as was their circulatory disturbance.

THE ALIMENTARY TRACT.

In considering the results of the examination of the alimentary system two factors were especially taken note of, namely, the presence of any evidence of a septic focus or possibility of septic intoxication, and the condition of nervous tone of the abdominal viscera. The examination of the mouth showed in very many men that the teeth might be taken as a source of septic intoxication. Many of these patients with neurasthenic

signs had a general pyorrhœa, and although its presence may not be proof of intoxication, yet it is definite evidence that the virus causing the infection has gained a foothold upon a soil which is not able to throw it off. That an intoxication must be present seems to be undoubted, but whether it gives rise to symptoms or not seems to be a question of tolerance of the individual. The same reasoning is applicable to the tonsils. Here it is often to be noted that there is a chronic enlargement with or without suppuration in the crypts. The condition of the bowels was inquired into, and in many of these men some slight derangement of function was noted. Quite a number of these men had been operated on for appendicitis.

I have already mentioned a striking feature was the want of tone in the abdominal muscles which was often associated with a similar atonic state of the stomach and intestines. There was in some of these men definite clapotage and apparent gastric distension. In fact the want of visceral tone made me wonder if the pain in some of the patients was not abdominal in origin. I considered this want of tone as further evidence of the vagal insufficiency in the involuntary nervous balance. The closest approximation to a description of the abdominal condition of these men would be vagal atony.

THE THYROID GLAND.

The presence of an enlarged thyroid in a soldier on active service is of fairly common occurrence, yet Graves's disease is comparatively rare. Of 1,200 cardiac examinations, roughly a quarter of the men showed an enlargement of the thyroid, whilst it could be said only about four per cent of the total men examined suffered from exophthalmic goitre. The clinical picture produced by hyperthyroidism, with its attendant over-action of the sympathetic portion of the involuntary nervous system and concomitant increased adrenal secretion, has so many features in common with the picture presented by this "irritable heart condition," that it is difficult to draw a sharp line of demarcation between them. This similarity has led to the expression of the opinion that the conditions are one and the same, but I would dissent from this view for many reasons. I think the lowered threshold of stimulation to nervous impulse is the factor in common, and cannot believe that the assumption of a hypersecretion of the thyroid is necessary to explain the increased excitability.

THE NERVOUS SYSTEM.

So much has been said in the opening part of this article with regard to the condition of the nervous system in the patients, that I shall merely indicate a few other considerations which occur to me as of interest. In all these men we made a routine examination of the various reflexes—conjunctival, pharyngeal, abdominal, cremasteric, plantar, jaw-jerk, triceps-jerk, supinator-jerk, knee-jerk, and ankle-jerk. Occasionally the visual fields were roughly estimated as to their extent. As already stated,

the bulk of the men so examined showed a neurasthenic state associated with the "irritable heart condition." One of the signs noted as existing in these men was a marked general tremor, and especially on stripping for examination, although the men constantly denied feeling cold. I have not the least doubt that this tremor was involuntary in the vast majority of these patients, although when dealing with them it was difficult to restrain a contemptuous feeling unless, as often was the case, the man's scars rebuked such a feeling.

We examined, as a routine, each patient for the eye signs, which are usually associated with Graves's disease, and found that in men in whom we did not think there was hyperthyroidism present, we obtained Stelweg's sign, or Von Graefe's sign, or both. Often we noted a marked widening of the palpebral fissure on attempted convergence. These signs occurred most often in men who were markedly neurasthenic.

THE GENITO-URINARY SYSTEM.

We made an examination of the urine for albumin in each man. The object was to exclude nephritis, as we met a few cases who complained of the "irritable heart condition," and whose urine was loaded with albumin. The test is necessary before putting these men on exercise. A few of these men complained of increased frequency of micturition, but I only remember one man with definite incontinence of urine. This is a point of interest in connexion with the bladder innervation.

TREATMENT.

During the first year of my work overseas my experience was confined to attempting to treat these patients in hospital. It was, of course, impossible to keep many of these men in the hospital for a longer period than three weeks, and my experience in the use of drugs was most disheartening. We tried digitalis, the various cardiac tonics, vaccines and sedatives. I thought that the action of potassium bromide was the most marked, and this was before I had come to look upon the condition as mainly a nervous manifestation. However, it was quite evident from a practical point of view that these men could not be recovered as fit for active service by hospital treatment. It was then decided to try treatment by graduated exercise on the scheme which had been used at the Military Hospital at Hampstead. At the outset we commenced drilling these men while they were hospital patients, but after a short experience decided that the hospital atmosphere was not suitable, as there was very a distinct possibility in the patient's mind of his failure to improve, meaning evacuation to England. The next stage was that all suitable D.A.H. cases were sent to the Convalescent Depot from the hospitals of the district. Captain A. V. Poyser, R.A.M.C., took charge of the treatment, and it is entirely due to his efforts that our scheme worked without the slightest hitch, and

that we were able to take good clinical notes of the condition of each man, at the start of the course, half way through, and at the end of the treatment. When we had treated and disposed of about 1,000 men, Captain Poyser wrote a thesis upon our results, which I hope he may be able to publish.

It was during my association with the Convalescent Depot that I learnt to appreciate so fully the fact that the Army is a school of practical psychology, where discipline is the basis of the curriculum which produces our magnificent British troops. I had always thought of this course of treatment by graduated exercise as very similar to Patterson's treatment of sanatoria patients by graduated labour, and conceived the idea that the benefit resulted mainly from auto-inoculation. I confess after seeing the treatment carried out in a convalescent depot I realized more fully the importance of atmosphere. I learnt to understand, from the efforts of those who were in charge of this branch of medical treatment of soldiers, how much the psychological element plays in the life of the soldier, and how his natural sporting instinct is manipulated by great therapeutic skill. Thus the whole course of the treatment by physical drill was enlivened by games of increasing degree of strenuousness. I was constantly told that my D.A.H. patients were the nippiest lot in the camp when at these games. The personality of the instructors was another feature. Our serjeant-major seemed to me to handle these men with the greatest tact. On several occasions this instructor remarked that some of the men were over keen at the games, and that they appeared excessively exhausted after the excitement was over. The treatment may therefore be looked upon as simply consisting of possibly auto-inoculation and gentle army "schooling." At the end of this course we examined each man rapidly, dismissed him, read over the clinical notes which we had taken, and decided his fate, i.e., active or base. Many of these men were remarkably improved, but the excitement of this final "strafe" made them often seem worse than when half way through the final course. It was my final opinion that the man had had a good test of his capacity of endurance by the course, and that it was not possible by clinical means to decide what was his total capacity in this respect. In other words, the final test of application of active service conditions must be the criterion, and we had reduced the possibility of any injury to the man to a minimum. It may not be out of place to remark, as a final observation, how much I thought these men were affected by conditions of the weather. I can best illustrate this by citing the fact that on successive days we had a series of thunderstorms, and the men examined all, to my mind, showed an excessive amount of cardiac irritability, so much so that I felt inclined to call them a lot of barometers, without at the time realizing how much the atmospheric conditions must strain their involuntary neuro-muscular reflex mechanisms.

PROGNOSIS.

As already indicated, a considerable number of these men were marked as fit for a trial of active service after the course of treatment. The majority of the remainder were marked as suitable for base work, where the strain to be endured came within their limited capacity of endurance. The ultimate prognosis, however, always struck me as best based upon our knowledge of the usual course of neurasthenia in civil practice.

In conclusion, I will again state the opinion that the problem of dealing with these men whilst they are still in the Army is a simple one compared to the question of their treatment when the Army has discarded them and they must return to civil life. It is to aid, if possible, in the solution of this problem that I have placed my view of the clinical side of the "soldier's heart" before you. This view I would reiterate is the result of the experience gained at a base overseas, and the few cases that I have already seen at home make me realize anew the complexity of the problem. I went abroad armed with an electrocardiograph, and the conviction that the "irritable heart condition" was a manifestation of cardiac disease, and I have come back obsessed with the idea that the syndrome is merely part of a general nervous disorganization which we have designated neurasthenia. Further, if it is possible from the study of this syndrome as a particular to infer the characteristic of neurasthenia as universal, I would consider the fundamental of this derangement of nervous integration as an increased reaction of the nervous system of the individual to an intoxication, which intoxication may be subliminal as regards the occurrence of symptoms and signs in the normal individual.

I wish to express my appreciation of the help which I received from Captain A. Brunwin, R.A.M.C., and Captain A. V. Poyser, R.A.M.C., during this investigation. It was through the influence of Colonel Sir John Rose Bradford, K.C.M.G., the Consultant Physician for the Administrative Area, that the opportunity to carry out this investigation was obtained. Lieutenant-Colonel C. Trimble, C.M.G., V.D., commanding the St. John Ambulance Brigade Hospital, established a Cardiac Department in the Hospital, and made our work possible by granting every facility we desired.

REFERENCES.

- [1] DA COSTA. "Irritable Heart," *Amer. Journ. of Med. Sci.*, 1871.
- [2] MACKENZIE, Sir JAMES. "The Soldier's Heart," *Brit. Med. Journ.*, January, 1916.
- [3] GASKELL. "The Involuntary Nervous System."
- [4] PARKINSON and KOLFOD. "The Immediate Effect of Cigarette Smoking in Healthy Men, and on Cases of Soldier's Heart."

NOTES ON SIXTEEN CASES OF BLACKWATER FEVER OCCURRING IN MALTA.

By MAJOR J. A. ARKWRIGHT.

Royal Army Medical Corps.

AND

ELIZABETH H. LEPPER, M.B., B.S.

Attached Royal Army Medical Corps.

THE following notes are founded on sixteen cases of blackwater fever which occurred during the months October, 1916, to April, 1917 (inclusive). The patients were soldiers who had been invalided during the preceding five months from Macedonia, where malaria and blackwater fever are endemic, to hospitals at Malta, where blackwater fever was not known to have occurred and where malarial infection does not take place owing to the absence of anopheles. Fifteen of the cases were first attacks, the sixteenth was a second attack of blackwater fever occurring in Malta three months after the first, which occurred in the malarial district above mentioned.

We are personally responsible for the greater part of the laboratory examinations and are indebted to the medical officers in charge of the cases for permission to make use of the clinical notes.

Since the causation and pathology are at present uncertain it is necessary to define blackwater fever as a clinical syndrome.

Essential conditions are that the patient must have resided in a malarial district for at least some months and probably have had repeated attacks of malaria, these conditions were fulfilled in all our cases.

The symptoms which are invariably present are hæmoglobinuria, fever, and a high degree of anæmia, appearing very early and increasing rapidly during the attack, and prostration. Some degree of jaundice and vomiting are almost constant symptoms and in our cases were only absent in Case 16, which was a mild second attack. Enlargement and tenderness of the spleen and liver are commonly present and often increase during the attack. There may be a considerable degree of abdominal pain, generally referred to the epigastrium or hypogastrium.

It is possible that two or three distinct diseases are grouped under the name of blackwater fever. However, a perusal of the cases recorded by Christophers and Bentley [1] and by Barratt and Yorke [2], and in the British Government reports on blackwater fever in tropical Africa for 1912 [3] and 1913 [4], leads us to the conclusion that the cases occurring in the tropics cannot be differentiated clinically from those which we have observed in Malta.

TABLE I											
No. of case	Name	1st or 2nd attack of Blackwater fever	Date of onset of haemo- globinuria	Interval between onset of Blackwater fever and			History of quinine treatment before onset of Blackwater fever	Species of malaria parasite	Date when parasite found	Examination for parasites during attack	Result
				Arrival in malarial district	First attack of malaria	Arrival in non-malarial country					
1	Me. . .	1st	10.10.16	Months —	Months 1-6 (50 days)	Months 1-4 (42 days)	Last 17 days, quin. sulph., gr. x, often vomited; 9.10.16, quin. hydr., gr. x	P.f.R.	8.9.16 and 9.9.16 ?	Negative	R.
2	Ja. . .	1st	23.12.16	12	5	1	Quinine continuously since onset of malaria	?	?	Negative	R.
3	C. . .	1st	25.12.16	11	5	2	?	?	?	Negative	R.
4	T. . .	1st	23.1.17	15	5	4	15.1.17 to 21.1.17, none; 22.1.17, quin. sulph., gr. xxx; 23.1.17, quin. sulph., gr. lx	P.f. P.f.C.	Aug., 1916 22.1.17	Negative	R.
5	K. . .	1st	24.1.17	11	4	3	4.12.16 to 3.1.17, quin. sulph., gr. xxx; 4.1.17 to 17.1.17, quin. sulph., gr. xx; 18.1.17 to 25.1.17, quin. sulph., gr. x; 26.1.17 to 9.2.17, quin. sulph., gr. xxx	P.f.R.C.	6.1.17	Negative	R.
6	Ma. . .	1st	10.2.17	—	5-5	2	Quinine continuously since September, 1916; 1.2.17 to 9.2.17, quin. sulph., gr. x; 10.2.17 and 11.2.17, quin. sulph., gr. xv	P.f.R.C.	31.1.17; 1.2.17; 7.2.17; 1.4.17	Negative	R.
7	R. . .	1st	11.2.17	16	4	3	20.1.17 to 11.2.17, none; 12.2.17 and 13.2.17, quin. sulph., gr. v	P.f.R.	21.1.17	Negative	R.
8	He. . .	1st	13.2.17	8	4	3	10.2.17 to 24.2.17, none; 24.2.17 to 27.2.17 (incl.), quin. sulph., gr. xxx	P.f.R.C.	27.2.17	Positive, 27.2.17, P.f.R.C.	R.
9	S. . .	1st	27.2.17	18	5-75 (or 6 years)	5-5	5.2.17 to 23.2.17, quin. hydro., gr. xx; 24.2.17 and 25.2.17, none; 26.2.17 to 1.3.17, quin. hydro., gr. xx	P.f.R.	18.1.17; 25.2.17; 2.3.17; 3.3.17	Positive, 27.2.17, P.f.R.C. and 2.3.17	R.
10	Hay. . .	1st	2.3.17	15	5-5	2	From (?) to 28.2.17, quin. sulph., gr. xv; 1.3.17, none; 2.3.17 to 4.3.17, quin. bih., gr. xv i m., and quin. sulph., gr. xv p.o.; 5.3.17 and 6.3.17, quin. sulph., gr. xxx; 7.3.17, quin. bih., gr. xv, i m., and quin. sulph., gr. x, p.o.	P.v. and P.f.R.	18.1.17; 25.2.17; 2.3.17; 3.3.17; 4.3.17; P.v.; 13.11.16, P.f.R.	Negative	D., 14.3.17
11	G. . .	1st	7.3.17	?	4-5	3-3	Quinine since July, 1916	P.f.R.	22.3.17	Positive, 22.3.17, P.f.R.	D., 27.3.17
12	W. . .	1st	22.3.17	?	8	5	2.1.17 to 7.3.17, quin. gr. x to gr. xx	P.f.R.	21.1.17	Negative	R.
13	Jo. . .	1st	7.3.17	7-5	5-5	2	Quinine regularly; latterly one dose daily till onset	P.v.	28.4.17	Negative	R.
14	D. . .	1st	1.4.17	16	5-5 (or 10 years)	4-5	Quinine, none for 1 week immediately before onset	?	—	?	D., 8.4.17
15	Y. . .	1st	4.4.17	?	8-5	4	Quinine sulph. for 6 weeks, gr. v; 12.4.17 and 13.4.17, quin. sulph., gr. xxx	P.v.	?	Negative	R.
16	Had. . .	1st 2nd	18.1.17 14.4.17	7 —	5 —	0 1-75		—	—	Negative	R.

TABLE II.

No. Name Age	Onset of illness	First observation of hæmo- globinuria	Duration of hæmo- globinuria, Quantity in 24 hours	Fever	Jaundice	Vomiting	Pain	Spleen	Liver	Hæmo- globin and red blood corpuscles in blood	Complica- tions	Quinine treatment and saline	Result
(1) Me. 22	9.10.16, T. 103° F.; hili, vomiting	10.10.16, 4 p.m., porter- coloured	12 hours 20 oz. in - 12 hours	3 days, T. 103°- 100° F.	+	+++ 2 to 3 days	+	Abdomen	++	..	..	9.10.16, quin. hydr. gr. xxx, p.o.; 10.10.16, 8 p.m., gr. x i.m. Rectal saline, 4-hourly	R.
(2) Ja. 21	23.12.16, early morning rigor, T. 103° F.; diarrhoea	23.12.16, 10 a.m., "café noir"	24 days 40 oz. to 70 oz.	13 days, T. 104°-5° -99°-8° F.	++ 1 week or more	+++ 3 days	++ Hypo- gastrum	+++	-	2.1.17, hgb. 16%, r.b.c. 0.89 M.	..	23.12.16., quinn. bih. gr. x i.m. " " sulph. gr. x p.o. 28.12.16-4.1.17, quin. bih. gr. xv, i.m. 24.12.16, noon, saline 30 oz., i.v.; 9 p.m. 60 oz., i.v. 26.12.18, rectal saline 8 oz., b. d.	R.
(3) C. 25	24.12.16, rigor, T. 101° F.	25.12.16, afternoon very dark, porter- coloured	4 days 73 oz. to 42 oz.	5 days, T. 103°-8° -99°-8° F.	++ 9 days	+++ 6 days	Hypo- gastrum	+	..	2.1.17, hb. 28%, r.b.c. 1.5 M.	..	27.12.16, quin. bih. gr. xv, i.m. 28-29.12.16, quin. bih. gr. x, i.v. 30.12.16, quin. bih. gr. xv, i.m. 27-29.12.16, rectal saline 10 oz. 28 & 29.12.16, saline 40 oz., i.v.	R.
(4) T. 22	23.1.17, T. 103°- 105° F.	23.1.17, very dark, porter- coloured	3½ days 63 oz. to 56 oz.	6 days, T. 105°- 100° F.	+	+++ 3 days	..	+	++ Very tender	..	..	23.1.17, quin. bih. gr. vii, i.m. 24.1.17 " " gr. x, i.m. 25.1.17 " " gr. x, i.v. 26.1.17 " " gr. x, i.m. 27-31.1.17, no quinine 25.1.17, saline 40 oz., i.v. " " 20 oz. rectal	R.
(5) K. 23	24.1.17, afternoon headache, T. 99° F.	24.1.17, 4 p.m., dark reddish- brown	2½ days 50 oz. to 60 oz.	3 days, T. 101°- 99° F.	+	+	Splenic region	+	-	..	..	25.1.17-29.1.17, quin. bih. gr. xv, i.m. Rectal saline 20 oz., 4-hourly for 3 days	R.
(6) Ma. 30	9.2.17, 10 a.m., T. 101° F., shivering, vomiting, aching	10.2.17, afternoon, dark reddish- brown	1 day	6 days, T. 103°-8° -99° F.	++ 14 days or more	+++ 3 days	Abdomen, upper part: no tenderness	+	+	15.2.17, hb. 32%, r.b.c. 1.363 M.	..	9.2.17, quin. sulph. gr. xxx, p.o. 10.2.17 " " gr. x, i.m. 10-13.2.17, saline 10 oz. rectal 4-hourly	R.

(7) R. 20	11.2.17, 3 p.m., slight shivering, headache; 4 p.m., vomiting; 6 p.m., T. 103° F.	11.2.17, 5 p.m., blackish- red	19 hours 8 oz.	3 days, T. 103°- 99.6° F.	+	11.2.17 once; 13.2.17 once	Epi- gastrum	+	..	11.2.17 hb. 63%, r.b.c. 3-3 M.	..	13-17.2.17, quin. bih. gr. xv, i.m. 14.2.17, saline, rectal, 20 oz. 13.2.17, " " " 4-hourly 14.2.17, " " " 6th day	R.
(8) He. 21	13.2.17, 6.30 p.m., T. 104.8° F. rigor; ill	13.2.17, 7 p.m., porter- coloured	28 hours 80 oz.	4 days, T. 105°- 99.8° F.	+	+ 3 days	..	+	..	18.2.17 hb. 94%	..	14.2.17, quin. bih. gr. xv, i.m.	R.
(9) St. 27	27.2.17, 5 a.m., vomited, T. 100° F.	27.2.17, 7 a.m., dark red	3 days 30 oz. to 66 oz.	4 days, T. 108.4° -99.8° F.	++ 3 days	+ 3 days	None	+	+	..	..	27.2.17-16.3.17, quin. bih. gr. xv, i.m. Rectal saline, 4-hourly	R.
(10) Hay, 29	2.3.17, 10 a.m., T. 104° F.	2.3.17, 3 p.m., reddish- brown; 5 p.m., "café noir"	2 days 57 oz. to 86 oz.	2 days, T. 105°- 100° F. (22 days, T. 104.6°- 100° F.)	++ 5 days	++ 2 days	None	+	+	7.3.17 hb. 26% r.b.c. 1-656 M.	Cystitis	2 & 3.3.17, quin. bih. gr. xv, i.m. 4.3.17, saline 40 oz., i.v. 2 and 5.3.17, rectal saline, 4-hourly	R.
(11) G. 33	7.3.17, 3 p.m., rigor, T. 103° F.; 4 p.m., vomited	7.3.17, 6 p.m., deep red	4 days; 8.3.17 anuria; 9-13.3.17 1 oz. to 7 oz.	3 days T. 105.4°- 100.4° F.	+	++ till death 7-13.3.17	In appendix region	+	-	10.3.17 hb. 38%	Suppres- sion of urine	7.3.17, quin. bih. gr. xv, i.m. 8.3.17 " " bih. gr. xxx, i.m. 9.3.17 " " gr. xv, i.m. 10.3.17 " " gr. xxv, i.v. 11.3.17 " " gr. xx, i.v. 12.3.17 " " gr. xv, i.v. 13.3.17 " " gr. v, i.v. Rectal saline, 4-hourly; sub- cutaneously or i.v. saline twice daily	D. 14.3.17
(12) W. 26	22.3.17, 2 p.m., rigor; 3.30 p.m., vomited, T. 104.6° F.	22.3.17, 3 p.m., dark urine	3 days 23.3.17 42 oz.; 24.3.17 none; 25.3.17 14 oz. normal colour; 26.3.17 inconti- nence	6 days T. 105.8°- 100.5° F.	+	+ 3 days till death	None	-	-	25.3.17 hb. 16%	Partial suppres- sion of urine	22.3.17, quin. bih. gr. xv, i.m. 23.3.17 " " gr. xx, i.m. 24.3.17 " " gr. x, i.v. 25-27.3.17 " " gr. xv, i.m. Rectal saline, 4-hourly 24.3.17, saline 20 oz., i.v. 24.3.17 " " 30 oz., i.v.	D. 27.3.17

TABLE II.—Continued.

No. Name Age	Onset of illness	First observation of hemo- globinuria	Duration of hemo- globinuria. Quantity in 24 hours	Fever	Jaundice	Vomiting	Pain	Spleen	Liver	Hemo- globin and red blood corpuscles in blood	Complica- tions	Quinine treatment and saline	Result	
(13) Jo. 23	6.3.17, 7 p.m., shivering, headache, sweating	7.3.17, 8.30 a.m., red	5 days with inter- missions 24 to 46 oz.	5 days 103°-6°— 99°-2° F.	+	++ 2 days	Headache	++	+	16.3.17, hb. 52%, r.b.c., 3-683 M.	..	7&8.3.17, quin. bih. gr. xv, i.m. 10.3.17, quin. hydr. gr. xx, p.o. 11.3.17, quin. bih. gr. xv, i.m. 12.3.17, " gr. xv, i.m. Rectal saline, 6-hourly	R.	
(14) D. 38	1.4.17, afternoon headache, feverish	1.4.17, afternoon, blackish red	5½ days 52 to 48 oz.	4 days 105°— 102° F.	++ 4 days	+++ 2 or 3 days	None	+++	+	7.4.17, hb. 24%, r.b.c., 1-376 M.	..	4.4.17., quin. bih. gr. xv, i.m. Rectal saline, 6-hourly	R.	
(15) Y. 31	4.4.17, 10 a.m., shivering	4.4.17, no urine; 5.4.17, 7 p.m., dark brown	4 days 3 oz. to none	4 days 104°— 107° F.	+++ 5.4.17 till death	++ retching 2 days, 5&6.4.17	Abdomen, especially epigas- trum	—	+	..	Suppres- sion of urine	4.4.17, quin. sulph. gr. x, p.o. 5.4.17, quin. bih. gr. xx, i.m.; 11 p.m., quin. bih. gr. xx, i.v. 6.4.17, quin. bih. gr. xx, i.v. 7.4.17, " " " 5.4.17, rectal salines, 20 oz. 4-hourly (3 retained); saline 40 oz. i.v. 6.4.17, saline 30 oz., i.v.	D. 8.4.17	
(16) Had. 21	1st attack "18.1.17" "rigor," 2nd attack 14.4.17	"18.1.17"	"1 day"	"Epis- taxis and melena"	..	14.4.17, quin. sulph. gr. xxx, p.o. No saline	R.

SUMMARY AND DISCUSSION OF THE SIXTEEN CASES.

The following description is based entirely on our sixteen cases unless the contrary is definitely stated.

The main features of the attack were much the same in all our cases, except in the three which ended fatally with suppression of urine, and in these there was no sufficient reason for suspecting a different disease.

Details of the most important facts which were common to all our cases are recorded in two tables. Table I deals with the history of the patient before the attack and the nature of the malarial infection. Table II gives some details of the principal symptoms and the facts relating to quinine treatment.

NOTES ON TABLES.

TABLE I, COLS. 5, 6, AND 7.—The intervals recorded are those between (1) the arrival in a malarial country (Macedonia) and the onset of the blackwater fever attack; (2) the first attack of malaria and the onset of blackwater fever; (3) the date of arrival in a non-malarial country (Malta) and the onset of blackwater fever, i.e., the minimum incubation on the assumption that blackwater fever is due to a special infection.

TABLE I, COL. 6.—Cases 9 and 14 had their first malarial attacks in India six and ten years ago respectively; their first malarial attacks in Macedonia were 5.5 and 5.75 months respectively before the onset of blackwater fever.

Quinine: Quin. hydr. = quinine hydrochloride; quin. bih. = quinine bihydrochloride.

The dose entered means the amount given in twenty-four hours unless otherwise stated, e.g., gr. xxx means gr. x *ter die*.

P.o. = per os; i.m. = intramuscular; i.v. = intravenous.

Malarial Parasites: P.v. = *Plasmodium vivax*; P.f. = *Plasmodium falciparum*; R. = Rings; C. = Crescents, e.g., P.f.R. = *Plasmodium falciparum*, only rings seen, no crescents.

In Cases 4 and 16 the microscopic diagnosis was made at a hospital in Macedonia and we had no opportunity of observing parasites.

TABLE II.—The date in Col. 2 is that considered to be the date of onset of the blackwater fever attack as shown by general symptoms. The date in Col. 3 is that of the first occasion on which "black water" was observed by the patient or medical officer. In Case 15 the onset of suppression of urine is given as the date of onset of hæmoglobinuria.

TABLE II, COL. 5.—*Fever*: The temperatures stated are the maximum temperature on the day on which the fever was highest, and on that on which the fever was lowest. Temperatures of 99° F. and below are not entered.

TABLE II, COL. 6.—*Jaundice*: + means a distinct yellow colour of the conjunctiva and skin, such as is seen not rarely in severe relapsing malaria; ++ means a more decided jaundice, such as may occur in "slight" "catarrhal jaundice"; +++ means a deep yellow colour which affected all the tissues, post mortem.

TABLE II, COL. 7.—*Vomiting*: + means vomiting on two or three occasions; +++ means severe continual vomiting.

TABLE II, COL. 9.—*Spleen*: + = palpable; ++ = two or three inches below costal margin; +++ = almost or quite to level of umbilicus in left nipple line; — = not palpable, no enlargement detected.

TABLE II, COL. 10.—*Liver*: + = slight enlargement; ++ = felt two or three inches below costal margin in right nipple line; — = no enlargement detected.

TABLE II, COL. 11.—*Red Blood Corpuscles*: 0.89 M. = 890,000 per cubic millimetre; 1.5 M. = 1,500,000 per cubic millimetre, etc.

R. = recovered; D. = died.

No entry in a column means no observation recorded.

PRODROMAL SYMPTOMS AND ONSET.

The onset of hæmoglobinuria usually appears to be sudden, though in some cases the first specimen of dark urine examined was not so dark in colour as that passed a few hours later. Commonly fever, shivering and vomiting precede by one to three hours the passage of porter-coloured urine. Sometimes there may have been similar attacks of fever and shivering on the two or three days preceding the attack and it is occasionally difficult to be sure that the attack did not really start twenty-four or forty-eight hours before the "black" urine was noticed. The prodromal fever and the fever at the actual onset closely resemble malarial attacks. Our observations agree with the remark of Christophers and Bentley, that neither the patient nor the medical man can distinguish the symptoms ushering in blackwater fever from an attack of malaria.

In three of our cases (Nos. 9, 10 and 12) the malarial parasites (*Plasmodium falciparum*, rings) were found in the blood a few hours after the first appearance of hæmoglobinuria, and in four cases, Nos. 1, 7 and 10 (*P. falciparum*) and 11 (*P. vivax*), trophozoites or schizonts were found during the fever which occurred a few days before the onset of blackwater fever. In one further case (No. 5) crescents were found two days before the attacks.

These facts illustrate the intimate association of blackwater fever with active malarial infection.

The type of malaria from which the 16 cases suffered was ascertained in 11 patients; in 5 patients no malarial parasites were found whilst they were under our observation, nor were past records of the parasites obtainable. Of the 11 which were diagnosed microscopically, in 9 *P. falciparum* was found, and in 2 *P. vivax*; for two of these diagnoses (one *P. falciparum* and one *P. vivax*) we are indebted to records forwarded from other hospitals nearer the Front.

Though no record of the finding of parasites was available in five cases, the clinical history clearly pointed to the occurrence of several attacks of malaria and in one of them pigmentation of the liver and spleen was found post-mortem.

Fever.

The temperature after rising to 102° to 105° F. at or soon after the onset of the attack usually remained high but irregular till the urine became of a normal colour, then fell rapidly and after two or three days remained normal. In a few cases a secondary or post-hæmoglobinuric fever occurred which was either associated with some complication, e.g., cystitis in Case 10, or was unaccompanied by any symptoms which suggested a superadded cause. In Case 2 a return of fever occurred two days after the first fall of temperature and lasted nine days, varying from 100° to 104° F. Both the primary and secondary fevers sometimes showed a tendency to tertian periodicity.

Anæmia.

There was usually extreme anæmia. The patient as a rule appeared blanched as after a severe hæmorrhage if the hæmoglobinuria lasted more than twenty-four hours, and the hæmoglobin in the blood fell to twenty-four per cent or even sixteen per cent. In a few cases in which the attack lasted less than twenty-four hours the percentage did not fall so low, e.g., sixty-two per cent and forty-two per cent in two such cases.

The anæmia appeared to be out of all proportion to the amount of blood, lost in the urine.

Jaundice.

The jaundice observed was of very different degrees of intensity. In Case 15 the conjunctiva and skin became yellow on the day following the onset of blackwater fever, and the colour became progressively deeper till death; post mortem, all the tissues were deeply bile stained. In five other cases (Nos. 2, 3, 6, 10 and 14) the colour was like that seen in mild cases of catarrhal jaundice and distinctly exceeded that observed in Cases 1, 4, 5, 7, 8, 9, 11, 12 and 13, in which it resembled the icteric tinge of conjunctiva and skin not uncommonly seen in severe relapsing malaria. In Case 16 no trace of yellow colour was observable. The jaundice often increased during the attack and began to fade after two or three days to a week. Bile pigment was only found in the urine in one case, No. 15, but the presence of a large amount of hæmoglobin may have prevented the detection of a small amount of bile pigment by the ordinary tests (HNO_3 and iodine).

The blood serum gave a positive reaction for bile pigment during life in four cases, Nos. 7, 8, 10 and 15, out of seven examined.

Hæmoglobinuria.

The appearance of the urine was usually quite characteristic. The colour was deep brownish red or blackish brown like *café noir* or porter, and a paler deposit which sometimes occupied $\frac{1}{4}$ to $\frac{1}{6}$ of the vessel appeared after it had stood an hour or so. If the urine was alkaline the colour was a very deep brownish red or crimson and the deposit was less in amount. The urine was often so opaque that it required dilution before a spectroscope could be used. In other cases spectroscopic examination of the undiluted urine in a test-tube showed absorption of both ends of the spectrum, leaving only the red part in which the band of methæmoglobin or of acid hæmatin was seen. Determination of the kind of pigment present in the urine was complicated by the fact that there was usually a mixture of pigments. Methæmoglobin or acid hæmatin was in most cases present in addition to oxyhæmoglobin. The spectra of methæmoglobin and acid hæmatin are very much alike and unless these pigments are present in fair concentration the band in the red, which is the most characteristic part of these spectra, is not seen. The spectrum of acid hæmatin may for this reason be easily overlooked in a pale brown

urine. Oxyhæmoglobin is, in part at least, rapidly converted into hæmatin in acid urine. A method for estimating the degree of hæmoglobinuria is detailed at the end of this paper.

In two specimens of urine from Case 11 no spectra of hæmoglobin, methæmoglobin or acid hæmatin could be seen, although the urine was dark brown and contained much albumin. This was apparently in part due to the turbidity of the urine which had probably been in the bladder for twenty-four hours before it was drawn off by catheter. That the colour was due to altered blood pigment (probably chiefly acid hæmatin) was shown by the appearance of a reddish-purple colour due to the formation of hæmochromogen, after the addition of strong caustic soda solution. This reaction is a useful method of demonstrating the presence of altered blood pigment, for hæmochromogen not only gives a very characteristic spectrum, but the absorption bands are much darker than the bands given by the solution of hæmoglobin or hæmatin from which it is derived. Hæmochromogen was easily obtained in blackwater fever urine with caustic soda alone without the addition of any reducing substance though occasionally the purple colour did not appear till the solution had stood twenty-four hours. The hæmochromogen (reduced alkali hæmatin) is seen at the bottom of the test-tube and the pigment in the upper part is alkali hæmatin.

The *duration* of the hæmoglobinuria varied from twelve hours to five days (average 2·9 days). The urine after being dark rapidly became normal in colour in the course of twelve hours or less, and as a rule remained free from blood pigment. On the other hand, slight temporary variations in the colour occurred and a paler specimen was succeeded in a few hours by one of a very dark colour, or the hæmoglobin completely disappeared for a few hours or a whole day, and then a relapse followed. Complete intermissions of this kind occurred in two cases, Nos. 13 and 16. When the colour of the urine had recently become normal the brown centrifuged deposit, consisting of casts and cells full of yellow granules if treated with caustic soda, gave the colour and spectrum of hæmochromogen.

The *quantity* of urine passed in twenty-four hours was often increased to 60 or 80 ounces and sometimes to over 100 ounces during the hæmoglobinuria. This was no doubt in part due to the saline injections given by the rectum or intravenously. Some cases running a favourable course passed only 36 or 40 ounces. In the three fatal cases, and in these cases only, the amount of urine was much reduced; in two cases, Nos. 11 and 15, to 2 or 3 ounces in the twenty-four hours; in the third case, No. 12, the quantity was rather larger but could not be measured owing to incontinence during the last two or three days of life.

Albumin.—In the darker specimens of urine, the coagulable protein formed a very dense cloud on acidifying and boiling, which after standing twenty-four hours often occupied quarter to half of the test tube. After

the colour of the urine had returned to normal a thick cloud was generally obtained for two or three days and a trace sometimes persisted for a week or even a fortnight.

Deposit.—In the first specimens of urine passed during a blackwater attack the deposit consisted chiefly of small yellow granules; in some cases larger yellow granules or globules measuring 1 to 4 microns (0·001 to 0·004 millimetre) in diameter, which at first sight resembled red-blood corpuscles, were also present. About the second day renal cells and casts and cell-casts crowded with granules appeared. The casts and cells were in most cases very numerous and towards the end of the attack renal cells and casts packed with large yellow globules were often seen. Cells and granules were usually found in decreasing numbers for two or three days after the urine had resumed its normal colour. The scanty urine excreted when there was suppression of urine contained no renal cells or casts as a rule. A few red-blood corpuscles were found in one specimen of urine from Case 14 and in no other case. Barratt and Yorke [2] record the occurrence of a few red-blood corpuscles in the urine of a number of blackwater fever cases. It is important that the urinary deposit should be examined as soon as possible after the urine has been passed, since red-blood corpuscles are rapidly destroyed in acid urine.

Hæmoglobinæmia.

The blood serum was examined in ten cases and in four of these, Nos. 6, 9, 14 and 15, was sufficiently coloured with hæmoglobin to give a spectrum in a tube 0·3 to 0·4 cubic millimetre in diameter. Of the other six, in which blood pigment was not found in the serum, in three, Nos. 1, 7 and 10, the blood was taken only a few hours before the hæmoglobinuria ceased, in one, No. 16, during an intermission of hæmoglobinuria, and in a third, No. 4, after it had ceased; in the remaining case, No. 8, which was a mild attack lasting twenty-eight hours, the serum was examined within a few hours of the onset but hæmoglobin was not detected. Citrated plasma also was examined in two of the above cases, Nos. 14 and 15, and hæmoglobin was found in this as well as in the serum. Plasma was also examined in Case 16 during an intermission of hæmoglobinuria and no hæmoglobin was detected. In Case 15 both the serum and the plasma were examined on the first and second day of the attack and both were a deep brownish crimson on each occasion. The colour was due to methæmoglobin probably with some oxyhæmoglobin, and also in part to bile pigment. The evidence brought forward by Christophers and Bentley [1], and by Barratt and Yorke [2], indicates that the hæmoglobinuria in blackwater fever is the result of the presence of free hæmoglobin in the blood plasma (hæmoglobinæmia). Barratt and Yorke succeeded in producing hæmoglobinæmia and hæmoglobinuria in rabbits by injecting hæmolytic serum. It has been pointed out by Christophers and Bentley that the presence of hæmoglobin

in the serum is no proof of the existence of hæmoglobinæmia, since some lysis of the red corpuscles may occur during clotting.

The Treatment.—Every case received one or more doses of quinine daily during the hæmoglobinuria. This was given in the form of the bihydrochloride usually in doses of ten to fifteen grains, and, as a rule, intramuscularly, but when intravenous saline injections were given the dose was added to the saline in most cases. Some cases received fifteen grains daily for a week or longer, others were given doses of ten to fifteen grains at irregular intervals. When the tendency to vomiting had ceased, quinine hydrochlor. or quinine sulphate was given by the mouth. In two or three cases the temperature chart suggested that the quinine had some effect in reducing the fever. There was no evidence that the quinine increased or caused a relapse of the hæmoglobinuria. Saline injections were given regularly every four or six hours by the rectum in almost all cases. In the more severe cases, especially when the enemata were not retained, one or more intravenous saline injections of one to three pints was given with decided benefit. Other treatment consisted of a single dose of calomel (two grains) to several of the patients. Subcutaneous injections of digitalin, pituitrin, strychnine, and in Case 4 ten cubic centimetres of normal horse serum were given subcutaneously the day before the hæmoglobinuria ceased.

Post-mortem Examinations.—Post-mortem examinations of our three fatal cases all showed the presence of malarial pigment in the spleen and liver, and also dark blackish colouration of the apices of the pyramids of the kidneys. Microscopic sections showed blocking of the collecting tubules with hæmoglobin globules and renal cells full of large granules, and in addition dilatation of the convoluted tubules and capsules of Bowman. These changes were most marked in Cases 11 and 15, in which death was due to suppression of urine, and were present to a less degree in Case 12, in which the fatal issue appeared to be in part due to the extreme anæmia in addition to partial suppression of urine. The changes found in the kidneys agreed with those present in Barratt and Yorke's fatal cases.

The liver of Case 15, in which there was a high degree of jaundice affecting all the tissues, showed obstruction of the bile capillaries by inspissated bile.

In all three cases the contents of the gall-bladder presented a remarkable appearance. The gall-bladder was full of dark green, almost black bile of the consistency of very thick porridge. It was almost solid and after incision of the sac was turned out in a solid mass.

The Causation of Blackwater Fever.

Three chief hypotheses have been suggested to account for attacks of blackwater fever.

(1) That the attacks are due to a distinct specific infection which is acquired in malarial countries, probably because the infective agent is a protozoon inoculated into man by mosquitoes similar to those which intro-

duce the malarial parasites. There appears to be no direct evidence in favour of this suggestion. The hypothesis is rendered less probable by the occurrence of cases of blackwater fever in Great Britain and elsewhere, weeks or months after the subjects have left a malarial country, necessitating, according to this view, a long and variable incubation period. The fifteen cases of first attacks here recorded occurred one to five months after the patients had arrived in a non-malarial country.

(2) That quinine is the cause. Most advocates of this view postulate a previous malarial infection of considerable duration. The above cases do not throw much fresh light on this question. One patient, No. 15, stated that though he was supposed to have taken quinine regularly, he had "dodged it" and had taken no quinine for a week before the onset of blackwater fever. In most of the cases quinine had been taken for a long period before the attack, in some apparently with fair regularity. In others, an increase of the dose of quinine, or a renewal of its administration, had taken place one to seven days before the onset of hæmoglobinuria. In one case the patient took no quinine for seven days, and then took 30 grains, 60 grains, and 60 grains in three successive days; the attack of blackwater fever began on the evening of the second day on which sixty grains had been taken.

When the administration of quinine had been renewed or the dose increased shortly before the attack of blackwater fever this step was always taken as a result of a return of fever suggesting a relapse of malaria and, consequently, the two events have an equal claim to be regarded as the exciting cause of the attack.

Every case received at least ten grains of the bihydrochloride intramuscularly during the attack and most of them had several such injections of ten to twenty grains. In four cases, Nos. 3, 11, 12 and 15, intravenous doses of the bihydrochloride of quinine were given with one or more pints of saline solution. These intramuscular and intravenous injections did not appear to increase the hæmoglobinuria or do harm. It so happened that two of the three cases which died, Nos. 11 and 15, received most quinine intravenously, but these doses were given after the onset of suppression of urine, and with the saline solution which was being injected on account of the anuria. Case 3 received two doses intravenously; the hæmoglobinuria ceased on the same day that the second dose was given, the first dose having been given the day before. Other cases which ran a short and comparatively mild course received fifteen grains intramuscularly daily for as long as seven to ten days.

These facts relating to quinine administration, though not conclusive nor different in kind from previously recorded evidence on the subject, do not lend much support to the view that quinine evokes attacks of blackwater fever.

(3) That blackwater fever is due to repeated attacks of malaria.

In considering the association of malaria and blackwater fever there are three striking points which come into prominence:—

(i) The patient has suffered from attacks of malaria on and off for months or years before the onset of blackwater fever.

(ii) Recent attacks of malaria have usually occurred and the blackwater fever is often immediately preceded by a malarial attack, e.g., Case 10 (see Table I), during which parasites may be found in the blood. Moreover, the symptoms immediately ushering in the blackwater fever are, as a rule, indistinguishable from a malarial attack. The evidence does not, however, point to blackwater fever being one of the forms of "pernicious malaria," such as cerebral malaria, pernicious hepatic attacks with severe jaundice, or pernicious renal attacks with hæmaturia. In these latter cases parasites are usually very numerous in the peripheral blood. It seems rather that repeated attacks of malaria produce a condition in the body which predisposes to the lysis of the red corpuscles and resulting hæmoglobinuria as suggested by Christophers and Bentley (see also Stephens and Christophers) [5].

(iii) The parasites are absent or rapidly disappear from the peripheral blood during an attack of blackwater fever.

Our cases agreed with the previous accounts quoted above in these three points, but the absence of malarial parasites or their disappearance during the attack of blackwater fever in our cases was not remarkable since quinine was given in every case, often in large and repeated doses.

The close association of malaria with the blackwater fever attack in some of our cases is described above and all our cases had had frequent relapses of malaria.

Method of Estimating the Degree of Hæmoglobinuria.

Direct estimation of the amount of blood pigment in the urine by comparison with a colour standard is very unsatisfactory because the kind of pigment is not always the same and there is often a mixture of pigments. Moreover, some of the blood pigment is not in solution, but is found in the deposit. A modification of Sahl's method in which the hæmoglobin is first converted into acid hæmatin appeared to be a solution of the difficulty.

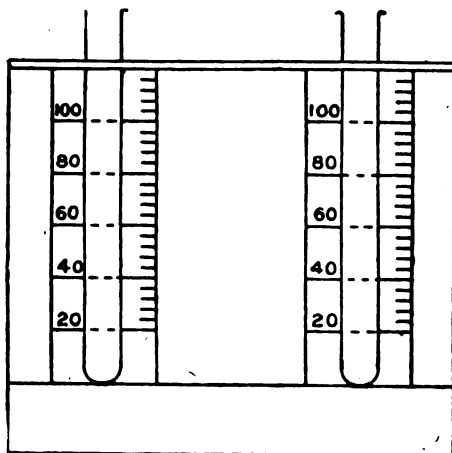
Method for Urine.—Since blackwater fever urine probably never contains more than twenty-five per cent of the amount of the hæmoglobin in normal blood (the highest figure which we obtained was 12·5 per cent) tubes about 1·5 cubic millimetres in diameter, i.e., twice that of ordinary hæmoglobinometer tubes, were used, and a standard solution of acid hæmatin was made with 0·5 per cent instead of one per cent of normal blood.

Several tubes of equal diameter were selected and calibrated with mercury at 1, 2, 5 and 10 cubic centimetres. The colour standard was prepared by taking 0·05 cubic centimetre of normal blood and making it up to 10 cubic centimetres with $\frac{N}{10}$ HCl saturated with chloroform as a preservative.

A wooden stand carrying a graduated scale as shown in the diagram was made and the scale so arranged that the 100 mark corresponded to the

10 cubic centimetre line on the tube, the 10 mark with the 1 cubic centimetre line, etc.

To make an estimation, 0.5 cubic centimetre of urine was placed in one of the tubes and 0.2 cubic centimetre of $\frac{N}{10}$ HCl added. The contents were well mixed and allowed to stand for a minute in order that the solution might become clear. Dilution was then carried out with water till the colour matched the standard. To obtain the percentage of hæmoglobin in terms of blood the number read off the scale must be divided by ten, since the amount of urine used is ten times that of the blood used in making the standard. Thus a reading of fifty means that the urine contains blood pigment equal to that in a five per cent solution of blood. (This we have called five per cent hæmoglobin.) If the percentage of hæmoglobin is small, less than two per cent, 1 cubic centimetre of urine should be taken for the test instead of 0.5 cubic centimetre and the reading divided by twenty.



That the whole of the hæmoglobin and altered blood pigment in the urine is really converted into acid hæmatin and correctly estimated by the above method was shown by the following experiments:—

(1) A solution of defibrinated rabbit's blood in water was taken and five cubic centimetres placed in two tubes A and B; to A was added 0.2 c.c. of water and to B 0.2 c.c. of one per cent solution of sodium nitrite. In tube B, methæmoglobin was found giving characteristic absorption bands.

The amount of blood pigment was then estimated in each by the method given above.

A. Exp. (1)	0.5 of A	+	0.5 c.c. $\frac{N}{10}$ HCl (mixed)	+	H ₂ O as diluent.	Estimated Hb	50 to 54 %
Exp. (2)	"	+	"	+	"	"	48 to 52 "
B. Exp. (1)	0.5 of B	+	"	+	"	"	48 to 52 "
Exp. (2)	"	+	"	+	"	"	48 to 52 "

The estimations before and after the formation of methæmoglobin were practically identical.

(2) The method was also tested by adding blood to acid and alkaline urines and estimating the hæmoglobin both before and after (1) placing the mixtures in the incubator at 37° C. for the night and (2) leaving it at the temperature of the laboratory (15° to 20° C.) for a fortnight; a few drops of chloroform were added to prevent the growth of bacteria. The estimated percentage in the different samples of urine did not alter during these experiments. These tests were necessary because when blood is mixed with urine and allowed to stand such changes take place in the colour and appearance of the urine that estimation of the hæmoglobin content by direct comparison with a colour standard is rendered impracticable, and it seemed possible that part of the hæmoglobin would have passed beyond the stage at which it could be estimated as acid hæmatin. Cf. observations by Barratt and Yorke [2] on changes in blood when mixed with urine.

This method of measuring the blood pigment in the urine was not adopted till most of the cases in the present series had recovered, but the results obtained in Cases 14, 15 and 16 are shown below. As a further illustration of the uses of the method the percentages found in a case of acute nephritis with deep red urine due to hæmaturia are also given. Case 14 (blackwater fever) after admission to hospital passed at least 1,640 cubic centimetres of dark porter-coloured urine between 3 p.m. April 4, and 6 a.m., April 6. The different specimens passed gave the following percentages of hæmoglobin (all the urine was not collected):—

April 4	3	p.m.	..	3.9 %	April 5	11.45 a.m.	..	3.9 %
	6.15	"	..	3.8 "	"	6 1	"	2.7 "
	8.45	"	..	4.3 "	"	6	"	2.2 "

Case 15 suffered from almost complete suppression of urine; the estimated hæmoglobin in the few ounces excreted on April 5 and 6 respectively was 12.5 per cent and 5.6 per cent. These estimations may be rather excessive owing to the presence of bile.

On the other hand, Case 16, a very mild case of blackwater fever, excreted urine containing only 1.7 per cent and 0.7 per cent when the hæmoglobinuria was at its height. It must be remembered that a large part of the hæmoglobin excreted is found in the deposit, which must be well mixed with the urine before a sample is taken for the estimation.

Taking Case 14 as an example and assuming that as much as fifty ounces of urine (48 to 52 oz. measured) were passed daily during the five and a half days that the attack lasted and that the content throughout was 3.9 per cent of hæmoglobin, then the daily loss of blood by the kidneys would be 1.95 ounce or 11 ounces during the whole attack if the hæmoglobin of the blood were normal. The hæmoglobin in the blood during the last two days fell from fifty-four per cent on April 4 to twenty-four per cent on April 6, with a red-corpuscle count on the last day of 1,376,000.

A loss of this order does not seem nearly enough to account for the

extreme anæmia produced during blackwater fever attacks. It must be remembered, moreover, that in Case 14 the attack lasted an unusually long time.

Errors Due to Associated Abnormal Pigments.—A slight degree of error in the estimation may arise if the urine contains much additional abnormal pigment.

(1) Urobilin is frequently present in large amount in the urine of blackwater fever patients but not as a rule till after the hæmoglobinuria has ceased. In order to see whether a large error would arise from this cause a solution of hæmoglobin (blood diluted with water) was added to a very highly coloured urine containing much urobilin. It was found that the estimation was not appreciably affected if the hæmoglobin content was at least two per cent, since in this case the urine was diluted not less than four times during the estimation.

(2) Urochrome may in the same way cause rather too high a reading, but in the case of a dark yellow urine which was tested, it did not alter the estimate if at least two per cent hæmoglobin was present.

(3) Bile pigment if present in large amount may affect the estimation. If the amount of bile pigment is very large, especially if the hæmoglobin content is low, the method is inapplicable. If a large amount of bile-pigment is present and the percentage of hæmoglobin is two per cent or more, the difficulty may be obviated by taking 0.25 cubic centimetre of urine instead of 0.5 cubic centimetre. We have, however, only once been able to detect bile in the urine of blackwater fever, and apparently it has only rarely been found judging from the records to which we have access.

Our observations have led us to certain definite conclusions regarding the causation, pathology, and treatment of blackwater fever. We feel some diffidence in expressing our views, because our experience has been restricted to one set of conditions, and we have had only limited access to the literature of the subject. Our observations in the main support the views of Stephens, Christophers and Bentley, Barratt and Yorke, and others.

Conclusions.

(1) Blackwater fever is due to malaria.

(2) It is predisposed to by a long standing malarial infection with repeated relapses.

(3) An attack of blackwater fever is precipitated by a relapse or recurrence of malaria.

(4) The ascertained *maximum* and *minimum* intervals in different cases in our series between the arrival in a malarial country and the first attack of blackwater fever were *maximum* ten years, *minimum* seven months; between the first recognized attack of malaria and the first attack of blackwater fever were *maximum* ten years, *minimum* fifty days; between the arrival in a country which was non-malarial and free from *anopheles* and

the first attack of blackwater fever were *maximum* five months, *minimum* one month.

(5) Quinine in the class of cases with which we have met has no share in producing blackwater fever, nor has quinine treatment during or after the attack any effect in prolonging or reproducing hæmoglobinuria.

(6) The jaundice of blackwater fever is certainly in some cases due to bile-pigment in the circulation.

(7) It is possible to estimate the total amount of blood-pigment in the urine, whether in solution or in the deposit, after converting it into acid hæmatin (modified Sabli's method). The amount of hæmoglobin lost by the kidneys is much greater than would be ascertained by an attempt at direct hæmoglobin estimation of the urine. We are convinced, however, that the kidneys excrete only part, possibly a small part, of the hæmoglobin which is lost in an attack of blackwater fever.

(8) The treatment which appeared to be of most value was intravenous or rectal administration of physiological salt solution (NaCl 0.9 per cent). Whether quinine is of value or not was difficult to decide, since all our cases had some quinine and the intensity of the attack was no doubt different in each case.

Our best thanks are due to the medical officers of St. Andrew's and St. David's Hospitals, who were in charge of the cases of blackwater fever, for permission to publish their clinical notes, and for their courtesy and constant assistance. Especial thanks are due to Major Campbell, R.A.M.C., Captain Fannin, R.A.M.C., and Captain Allen, R.A.M.C., and Dr. Bell, Dr. Gilchrist, Dr. Gorrie, and Dr. Rougvie, medical officers attached Royal Army Medical Corps, of St. Andrew's Hospital, and to Lieutenant Barrett, R.A.M.C., and Dr. Hollway, medical officer attached Royal Army Medical Corps, of St. David's Hospital.

Dr. Hollway not only supplied careful clinical notes of six cases, but by examining many blood films was able to establish a diagnosis of the species of malarial parasite in all her cases.

We were very fortunate in having the advice of Colonel A. E. Garrod, A.M.S., in connexion with the spectroscopic work and the identification of urinary pigments.

REFERENCES.

- [1] CHRISTOPHERS, Capt. S. R., and BENTLEY, C. A. "Blackwater Fever, No. 35. Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India." Simla, 1908.
- [2] BARRATT, J. O. W., and YORKE, W. "An Investigation into the Production of Blackwater," *Ann. Trop. Med. Parasitol.*, Liverpool, October 1, iii, 1, pp. 1-256. 1909.
- [3] Report on Blackwater Fever in Tropical African Dependencies for 1912. Presented to both Houses of Parliament, 1914. Cd. 7211.
- [4] Report on Blackwater Fever in Tropical African Dependencies for 1913. Cd. 7792.
- [5] STEPHENS, J. W. W., and CHRISTOPHERS, S. R. "Blackwater Fever" Report. *Malaria Comm. Roy. Soc.*, London, 5th Series, pp. 12-27.

SOME MUSINGS OF AN IDLE MAN.

BY COLONEL R. H. FIRTH.

I.

I PICKED up the daily paper, a few days ago, and saw the death announced of a man who had been a fellow-student with me and an intimate friend of early days. How many years ago, I was reluctant to estimate. His path had diverged widely from my own and we met but rarely, still the notice of his death roused many memories of happy days, of occasional riotous living, and of consistent rivalry in the schools. He and I had competed for many prizes and it was satisfactory to recall that I had more firsts than he had. He was a dear good fellow, as generous and sporting as he was industrious and clever. He was what they call a brilliant young man, and it was around that brilliancy that my thoughts wandered. It comes quite naturally to call him a brilliant young man, but how difficult to refer to him as a brilliant middle-aged man. It seems as if there is a time of life at which most of the brilliant cease to be brilliant, and that time appears to be the moment at which men engage in the serious business of life. I believe that I myself was occasionally referred to as being a brilliant young man, but what little brilliancy I may have had soon got rubbed off and I found that it is easy to be brilliant only when you are doing nothing in particular and have no responsibilities or, at any rate, doing nothing for which you are paid. The moment you begin to earn money or try to earn it, the difficulty of being brilliant increases many times. Possibly, therein lies the reason why middle-aged men are so dull; for one thing, it is difficult to be brilliant over a task imposed by necessity and, for another, the world, most certainly the official or service world, does not want or encourage you to be brilliant. Those who applauded your brilliance before, now become impatient of it, and the safe course is outlined by the old tag, "*medio tutissimus ibis*." Emerson has put it well: "The moment a youth sets to work to earn his living he is intellectually married and must settle down to a different state of existence without attempting to prolong the airs and graces of youth."

Of course, there are men who will not consent to this change, for they persist in their brilliance much as an elderly coquette persists in the exercise of her charms. These, however, are the people who are more impatient than youth itself at the dullness of successful middle age; but, for all that, their brilliance is forced, because youth loses its charm when it is no longer young. There is no getting away from the fact that there is a season for everything, and the season for brilliancy is over for the man who is past 25. The thought comes—if only brilliant youth knew how many of the dull were brilliant once it would be less confident in its own

brilliance. But youth sees no likeness between middle age and itself; it thinks ever that the last generation must be the dullest ever born because it is just that generation which it sees at work. I believe Titian was a brilliant painter until well over ninety years of age, but Wordsworth had lost all his brilliancy as a poet by the time he was forty. Much as we may lament our loss of brilliancy, yet it is remarkable how cheerfully we face that loss. We realize that our business in life is to do rather than to be. By doing our best at what we are doing, we forget how brilliant we once were when doing nothing particular; or, we remember it only when we see the brilliance of the next generation with pleasure and a little sadness. Young men may wonder why and how we older ones can be so dull, but they will learn the secret only too soon, and meanwhile it behoves them to be kind to us. We were sparkling fellows once, but we have ceased to sparkle so that we may live. Therefore, let brilliant youth be not too contemptuous of middle-age dullness; it has not faced the ordeal that all brilliance must submit to. If the brilliant youths of this day can keep their brilliancy through all the dust of sweeping offices or whatever other task is set them in the struggle for existence, then they will have the right to laugh at our dullness; but, only then, and that then is as far off as the Greek Kalends.

II.

We constantly see references to what is called the *moral* of troops. It is a word we have taken from the French and very frequently spell wrongly by adding an "e," which then makes it mean fair-dealing or honesty. By *moral*, one means that something the need of which by the soldier was never greater than now. Formerly the acquirement of that degree of discipline, confidence and spirit, which the French call *moral*, was a question for the professional soldier only, but, in these days, it affects the whole manhood of our race. Fortunately, a general high standard of intelligence makes the acquirement of the asset relatively easy. If we analyse the quality, we find there is a *moral* of the officer and a *moral* of the other ranks. The latter is largely a matter of environment and food supplemented by good leadership. It is something automatic in nature and manifested by good spirits, cheeriness and confidence. The *moral* of the officer is a more delicate thing to acquire and perhaps cannot be taught, for it embraces the whole art of leadership, which itself is the womb of *moral*, and many men are incapable of leading their fellows. In plain language, it is not every worthy man whose *métier* it is to be an officer and, unless it be his *métier*, that man should not be placed in the position. We all remember the centurion of the Scriptures, and, just as the officer of to-day is tested by the way in which he says "Go" and "Come," so the man is tested by the way in which he "goeth" and "cometh." Whether the men respond by going and coming with hesitation and misgiving or with speed and confidence depends on how much they mistrust or believe

in the officer. It is a great gift to have the knack of managing men, some men being born with it, but not all men can be taught it.

There are some who think that a good officer is born not made. Personally I doubt the truth of that, for the fairest field will grow weeds instead of corn if not cultivated, and a barren field will grow corn if it is tilled. Probably, the greatest influence of *moral* is in respect of its control over fear. Every man is susceptible to fear, and because it is the skeleton in every soldier's knapsack it is the one moral factor more potent for evil than any other. There are a few men of whom it can be said that they are so little shaken by fear that it is no burden on them: the greater number of men are susceptible to fear, but their self-respect is proof against any possibility of their being betrayed by it. These are the people who do not want to die, but would much rather die than be seen to flinch. Then at the bottom of the scale are a few miserables whose moral strength is incapable of overcoming fear; they are the men who would sustain any disgrace rather than submit themselves to great bodily danger. For all these types the development of *moral* is a great help, and when the officer can show to his men that he is as superior to them in all moral qualities as he is in rank, he has gone far towards developing his own *moral* and theirs too. It is the curious combination of tact, efficiency and sympathy in the officer which engenders that still more extraordinary spirit of cheerfulness, even under acutely depressing conditions, that establishes the *moral* of an aggregation of men. Emulation and *esprit de corps* are valuable factors, but they must not be confused with those vulgar vices jealousy and cheap swagger; these latter are destructive of respect, confidence, contentment and comradeship. Respect is a valuable moral factor, but it must begin at home. If a man does not respect himself, he must not expect others to respect him.

The whole question of *moral* is one of the most interesting of psychological studies, and nowhere does one find a greater field for observation on these points than in the new armies. Napoleon is said to have remarked that he would rather have an army of stags led by a lion than an army of lions led by a stag. It is epigrammatic but true and, in quality of leadership, expresses the whole truth. We need to remember that men can so saturate themselves with the will to conquer that, even if they fail of conquest, they can at least render themselves invincible in a real sense. This is true of both officers and men, and the latter can best catch the infection of *moral* from the former.

III.

The appearance of a certain Gazette gave rise to some caustic remarks in a mess in which I live. As one listened to the comments regarding certain people being members of a mutual admiration society, one was reminded of Æsop and his fables. Admitting that there may have been some taste of sour grapes in the mouths of the more talkative of our

number, still, one found it difficult to avoid reflection on the general question. Of course, for men outside the pale there is something very irritating about a coterie whose chief characteristic is admiration of each other, much as there is often something irritating in the infatuation of lovers. With these latter, however, we can be lenient, as we all have been or may be in love. In both cases illusion plays a big part. However true this may be, it is difficult to deny that there is something derogatory in our irritation at what are called mutual admiration societies. That irritation is but another word for envy of a little world within a world, and whose inhabitants seem to have some secret of power denied to ourselves.

In my younger days I moved in certain artistic circles, and was brought much in contact with a set of men and women who had been and were much under the influence of Rossetti, and who all admired each other and all their work. To me, as a Philistine, they were amusing people for whom I had an active scorn, but maturer years have convinced me that had it not been for their association with the master and with each other, few of them would have attained the eminence they did reach and so much above their natural powers. To them, geese of the right kind were always swans, and many geese became swans by mere contact with and suggestion of the others. I have no desire to be cynical, but undoubtedly the most mediocre of them were redeemed from mediocrity by the fact that they could recognize a teacher in their master and in each other. It was this fact which distinguished them from all outside, and which was the basis of their mutual admiration. In official circles, the same is operative; accident often brings a set of men together, but common tastes and a common aim are a bond of which mutual admiration is the natural result. Their idealization of each other may find expression in Gazettes, but the ideal is based upon realities and a freedom from all delusions about human nature. Their guiding philosophy is that it is a greater error to mistake swans for geese than to mistake geese for swans; the latter may be a matter of nomenclature but the former never so.

IV.

The juxtaposition on the same page of a daily paper of a summary of our losses in this War and the latest returns of the birth, marriage and death rates of the home population gives food for thought. It is an old question, but one about which we cannot think too much. Last year¹ we lost in round numbers 100,000 men killed, or about half as many again as the deaths from tuberculosis, which is our most deadly disease; but tuberculosis does not take our best men. Meanwhile, what was happening in compensation? The only true compensation for deaths is births, and yet the birth-rate for 1915 is the lowest on record, or 21.9 as compared with

¹ This was written in February, 1916.

the previous lowest of 23.6 in the preceding year. To make matters worse, the civil death-rate rose much above the average of the last ten years. One is not much surprised at this latter fact as the death-rate must rise the more we become a nation of elderly people. Before the commencement of this century, the rate of increase of the age-group (15-20) was at least four times that of the age-group (65-70). Between 1901 and 1911, however, the actual growth of the younger population was some 86,000, while the growth of the older group was 156,000. Further, these disquieting facts are not softened by the circumstance that the present infantile mortality rate of 110 is the highest since the hot and unhealthy summer of 1911.

No matter how we look at the question, we have to admit that 1915 was a bad year, and the irony of the position is emphasized when we realize that the same period saw our Imperial possessions increased by many hundreds of thousands of square miles. Thus, our Imperial responsibilities have been and are increased while the white man, whose burden they are and will be, is failing in the task of maintaining the living foundations of empire. So much for the question of numbers. As regards quality, the racial prospect is almost as serious. The dysgenic influence of the war touches only one sex, but maternal alcoholism, distinction between social classes and the disinclination of our best women to marry under present conditions involves the other sex and next generation, besides aggravating the whole case. Disturbing as the facts and the thoughts which they raise undoubtedly are, still there is nothing inevitable in the Imperial fate towards which we seem to be drifting. The range of remedial action is immense and its possibilities adequate if the need be realized. The lines of action are clearly defined and point to concerted and national endeavours to secure and safeguard ante-natal, natal and early infantile stages of nurture. Further, on the Imperial plane, we need to remedy that great factor of our low birth-rate at home and in the Colonies which depends upon the excess of women at home and the defect of them overseas. If returned soldiers are to emigrate and populate our new and old territories, we must see that those who go take wives with them. The writing on the wall is plain, and we need to rescue eugenics from being a cover for opposition to certain social reforms. The goal for which all should strive is the preservation and increase of the race. In so striving, there must be no hiding of the truth, but the dissemination of knowledge of facts and needs; the needs are a recognition and fulfilment by women that Nature intended them to be the mothers of children with, once the children are born, individual and corporate effort to secure their survival. Our profession has done much for individual hygiene, surely it is time that it worked explicitly for racial hygiene? Let us not forget that each one of us is or ought to be a teacher, and our duty to ourselves and our race is to make the heads of our fellow compatriots not graves but mines of knowledge concerning the facts of this national question. It is for us

all, be we in civil or military life, to educate the laity, making facts plain and not mincing words as to the remedy. Only if we be wise in such ways can the innumerable unborn of our race inherit from us the vital means wherewith to discharge their task, as the trustees of the greatest empire and of the highest ideals which the world has known.

V.

I have just come back from a conference at Army headquarters. There, a man had explained that his corps was wonderfully free from a certain disability and, suddenly, interrupted his remarks by saying, "I touch wood," and grasped the back of a chair. As I rode back in the car to my own headquarters, I got thinking over the whole incident and am tempted to jot down one's thoughts. Now, it is evident that we have in this incident the survival of a curious custom which helps to make us understand what superstitions were to people who really believed in them. The man who was the cause of these notes is, I happen to know, one who would be much hurt if anyone said he was superstitious. Yet, unconsciously, he betrayed a fear of a Nemesis provoked by boasting so much that by a habit he checked the confession of a pleasure or happiness. I own that I have been guilty of the same act myself, and admit that it is an expression of half unconscious misgiving which overcomes me now and then, indicative of a fear to believe that I have weathered certain troubles and still more afraid to say so. At such times, superstition is no mere romantic diversion but a relic of the real intimidating demon of the past.

I have a sister-in-law who is a veritable high-priestess of small observances of this kind, and she is a fruitful source of amusement to me. Often, as I have noted her quaint remarks or acts, has the thought come that superstitions of the kind are but survivals of a more primitive state of society. There was a time when superstition was a real and overshadowing fear to everyone, and, as people had a complete belief in their superstitions any rites which they imposed were regarded as disagreeable necessities. With us, under a looser dispensation, such superstitions as we retain have become romantic curiosities to frivolous minds. The killing of wild animals is no longer necessary as a means of getting food, but it delights people from its spice of danger and its chances of failure or success; in the same way, superstition being no longer seriously believed presents an element of fear which appeals to certain minds. Their real fears are elsewhere, and these sham fears cause enjoyment simply because they are incongruous with our conception of the universe, and do not entail the constant and cumulative anxiety caused by real fear.

Another factor which tends to encourage the observance of such acts as taking one's hat off to the new moon, or turning one's money at the sight of her, and the reluctance to sit down thirteen at table is the circumstance that many of us are a trifle bored by our sense of the relation between cause and effect, and we strive to explain or imagine escape from it. Our

friends who do these things know perfectly well that the course of events will not be affected really by helping some one else to salt or walking under a ladder, but it is pleasant to them to believe in a surviving arbitrary streak in the constitution of the universe and we, of less sensitive minds, find the dullness of the day relieved by a streak of unreason betrayed suddenly in rational people. The reader must not think that these thoughts are expressive of any personal sense of superiority; far from it, they are but an attempt to argue out why and wherefore certain lapses to a primitive mode of thought occur. They come down to us from a time when there was no sense of the relation between cause and effect, and when everything out of the common was regarded as the interposition of some unknown power. None will admit a wish to return to this conception of things, but few of us are free from a pleasure in primitive thrills of the kind, for they enliven the dullness of civilized life, very much as some ancient curio contrasts with and relieves the dullness of photographs and other timid ornaments of a modern drawing-room. In thus thinking of the ritual of the superstitious, we obtain a warning that our modern security is not secure and our modern reason not yet wholly rational. We find that we are less civilized than we thought, and that we must not play tricks with our minds out of mere lightheartedness. How much each one of us needs the lesson can only be answered by ourselves.

VI.

The present time of worry and anxiety is a fruitful source of growls and grumbling. At lunch the other day, a man came in and exclaimed, "Oh that I had wings like a dove, for then would I fly away and be at rest." He belonged to our "Q" branch and evidently had been having a bad time of it in the office. Strictly speaking, rest is not immediately to do or be, but to cease from doing and being. It is difficult to associate rest with a bird, because it is among the most restless of creatures; that is, it is either all movement or all repose. Yet, to many people in our modern life, the idea of rest is inseparable from that of movement. When we are weary or bored, most of us feel sure that if we could be somewhere else we should find refreshment in the change and, in our modern version of the Psalmist's aspiration, we should substitute the words "motor-car," "yacht" or "wagon-lit" for "dove." The funny part about it is that, when we have thus gone in search of rest we rarely find it, but stumble merely on to a different kind of weariness. The truth is, rest like happiness is one of the many things which are not to be found by pursuing them. Rest must be a visitor and not a captive; moreover, rest is a shy visitor for whom preparation must be made and then perhaps if we keep still it will come.

All who have been in the East are familiar with the degree of cultivation of the art of repose manifested by Orientals. Their idea of rest is repose in its simpler forms and in marked contrast to the Western

gospel of being strenuous for its own sake, and as the only way in which life could be made worth living. To many, what we call strenuousness is but another name for restlessness and inability to keep still. There is no merit in activity for its own sake or irrespective of the ends to which it is directed. Unless watched, such strenuous activity becomes a disease whose symptoms are only to be allayed by a constant indulgence in the irritant which causes them. Examples of this misdirected or pathogenic activity are familiar to us in the women who can never be still, who hate to be alone, and who must be ever rushing here or there. True, this time of war has pulled up many of these women as with a bit, and not a few are working efficiently and well, and also glad at the end of the day to sit alone and enjoy repose. This is one of the few good things we have obtained by serious war, and it is the discovery of work that has brought to many restless women the discovery of real rest also. For the one is the complement of the other, so much so that it is nearly as important to know how to rest as it is to know how to work. These and others, but a few degrees different, are the people who have discovered their own homes and their own resources for the first time. And although over almost every home there is a shadow, since that home must be the centre of real things, so people, instead of running away from their sorrows, are able to remain and face them, and perhaps to find that such sorrows are not all bitterness.

It may be paradoxical, but war with all its horrors has given to many as well as taken away. It seems a terrible cure, and one prefers to think that the benefit comes less from the cruel realities of war than from causes which are incidental and truly good in themselves. One may be an optimist, but the signs of the day suggest that organized idleness has disappeared, and that both men and women find real work to do instead of what was only make-believe. From this real work comes weariness, and from that weariness comes rest. So, in this manner, a benefit from the war lies in the circumstance that many people have learnt to rest in a new way, namely, by being still. The particular kind of fidgety restlessness that was afflicting the modern world, and of which perhaps this war was the culmination, has been soothed, and so for some, at least, the present great upheaval is by no means all on the wrong side of the account.

VII.

Going home on leave, lately, one of the first things to arrest my attention, on a hoarding as the train ran slowly through Folkestone, was a placard on which the words "Bad Form" stood out prominently. Subsequently, I found out that the placard was an appeal to women to refrain from extravagant dressing. During the journey to town, I got thinking over the phrase "bad form," and to analyse the question as to whether there is any criterion of right and wrong in matters of "form" or taste. Good or bad "form" is nothing but a colloquial variation on

having or not having good or bad "taste." This is an instance of how thought is curiously at the mercy of words and often confused by the use of words in different senses. Now, one man may like red hair on a woman and another dislike it, also one man may prefer spending his holiday in the Alps and another at Swanage or St. Andrews. We may regard each of these likes and dislikes as a matter of taste, but we may not label them as being either good or bad taste. If we speak of good or bad taste and form, we refer clearly to those likes and dislikes into which the will and mind enter and which can and ought to be affected by judgment, the outcome of training or experience.

There was a time when people thought of taste as something arbitrary and unconnected with intellect. We think differently now, since we speak of good or bad form and taste in matters of conduct. It is an interesting development as it indicates that we are aware of a connexion between beauty and goodness, and judge of the motives of an action by the manner in which it is performed. This appreciation of manner of doing a thing is further an artistic standard, for a work of art is judged by the manner in which it is executed rather than by the motives of the artist. In matters of conduct, bad form or bad taste is only brought home to us when it makes some appeal to the emotions and makes it badly. A man may be brutal, selfish and ruthless, but so long as he does those acts of conduct without any attempt to conceal their character by incongruous excuses, we do not label his actions as being bad form or in bad taste. In many of our daily actions we display no kind of taste or good and bad form, because we make no kind of emotional appeal in our performance of them. So long as we perform our actions simply and without trying to produce effects not proper to them, we can escape the imputation of bad form. Our dislike to bad form in matters of conduct would seem therefore to be dependent on the recognition of some kind of insincerity that disgusts us. Many acts may be in bad form though not wrong in themselves; but bad form is the product of a man's whole nature because if he could see that it was bad he would not be guilty of it. His acts are such as would move him if some one else did them, and any appeal made to us in what we deem is bad taste involves the assumption by the appellant that our own taste is the same as his own, and then follows our resentment and desire to prove that it is not so. It is always more difficult to protest against bad form than against actual wrongdoing; for how is one to prove that it is bad form?

This brings us back to our original thought; is there any criterion of right and wrong in matters of taste or form? A tempting answer is "no," or to say *chacun à son goût*. A moment's reflection, however, suggests that in all questions of form or taste there is as much right or wrong as there is in morals. We all admit that, in matters of conduct, there is a definite standard of right and wrong. In such cases, the only criterion is the judgment of the right-thinking man, or of the man whose habitual

right conduct has endowed with a right judgment. Similarly, in matters of form, the man of good taste is also best fitted to decide. The critic may here say, "I recognize the need of some standard of conduct if I am to live at peace with my neighbours and myself, but whether I have a sound standard of taste is a question which concerns mainly myself." True, but good taste and its brother good form is indissolubly associated with good conduct, as judged by the standard of the period; further, good taste is partly an inborn gift and partly one cultivated by practice and study. Just as there are men born with an inherent bias towards virtue, so there are men born with an inherent gift of good taste. In each case, the study of great examples is needed to refine and perfect the native gift. The human mind has a certain timidity which dislikes what is precise and original, hence imitations, vague and sentimental things have their short day. It is the mark of bad form to be taken in by these, to prefer the imitation to the original, hence bad taste is usually deceived only by the frauds of its own time; and the man who has good form is he who conforms most closely to the best ideals of the age in which he lives. Tastes vary from age to age, but certain things delight all generations and these are the materials on which all good taste must be based, and the man who bases his conduct on those things is he who has good form. It is only by the study of the high thoughts of men and the contemplation of noble deeds that an unimpeachable good taste can be acquired. The judgment of the world refined and rectified from generation to generation is final and brooks no appeal, and St. Augustine's dictum *securus judicat orbis terrarum* comes back to us as meaning more than we used to think it meant. Few of us who wrote that line in our copy-books as boys realized that a day would come when the principle which it inculcated would need to be placarded all over the country to prevent people flaunting about in fine clothes, cheap furs and shoddy jewellery, pretending to be better than they are. In other words, we are asked to show good form and to judge conduct as the old Greeks judged it by regarding the æsthetic and moral standard as the same. Unfortunately, for the greater number, the words and confession which Ovid put into the mouth of Medea in her famous soliloquy are only too true, and most of us have to say, in respect of this matter, *video meliora proboque, deteriora sequor*.

VIII.

Circumstances have placed the Corps Headquarters to which I belong in a true piece of rural France and one's surroundings in the balmy days of early April make one realize that the biology of spring is a book of many pages. Our spring does not come in one triumphant rush; it promises and disappoints, it advances and retreats, but still we feel the difference between its earliest signs and the last belated day of autumn. Even the birds feel the difference, and seem warned by the change in the sunlight and the stir of the wind that their time of work and happiness is coming.

One looks for early migrants and wonders how they, in their southern winter quarters, begin to grow restless and remember the pleasant woods of northern Europe. For those wanderers there can be no news except by change in Nature, and they do not know the extent of man's folly and ambition as imprinted on the corn and beet fields of France. For them, the world is but the earth with its natural changes and future, and though they have to wage the struggle for life they have made no cult of it. Death comes to them, but it is not foreseen, glorified or prepared for. Possibly they have no souls, but having none they do not misuse them, and we can understand why the Teacher spoke of them and the lilies of the fields to men for whom the soul had become a trouble to itself.

I look about me and all around is the message that this is the time of year associated with that capacity of becoming young again which so many living creatures, including man, have lost in greater part. Each walk I take shows me signs of rejuvenescence in Nature, but in the world for which man is primarily responsible it is all too easy to find examples of senility. Such senility, marked by degeneration or inhibition, liability to disease, and an ungearing of important parts of the organism is more or less unknown in wild Nature, or that which has not suffered from man's interference. One asks the question, Why? The answer seems to be that the conditions of the struggle for existence in Nature are such that senility is not tolerated, and that the average duration of life is punctuated in reference to the welfare of the species. Plants and creatures come to a natural end when their processes of rejuvenescence fail to keep pace with their processes of senescence.

As distinguished from senility, senescence is an all but universal retardation of vigour or resisting power, and itself the consequence of changes in the colloid substratum which forms the chemico-physical basis of life. In plants and some creatures, such as the protozoa, the recuperative processes are so perfect that natural death need never occur, or at least be long delayed. In them the colloidal and protoplasmic substratum can be restored piecemeal, and the creature never grow old. But as life becomes more complex and the organism more of an agent, it becomes more difficult for the processes of rejuvenescence to keep pace with those of senescence. As one looks at the bursting buds the thought comes, Has not this led to special periods of rejuvenescence in plants, or to those remarkable phenomena of a return to almost embryonic life familiar to us in the pupa stage of flies and insects? In man, the physiological stability of his protoplasmic substratum and its associated increase of individuality would seem to limit the capacity for rejuvenescence. The penalty is individual death, for the very processes in the human organism which lead to death are the processes which make man what he is. As to why we grow old, many answers have been given. Metchnikoff's theory of an auto-intoxication from the large intestine is familiar to most of us; others refer senility to mere wear and tear. None of these theories are of

universal application, and all fail to answer another question—Why do not all animals exhibit the perfect recuperation to which some have attained? Some worms have the capacity for periodically becoming young again. Thus, a Planarian may separate off a third of its body, which speedily grows into a whole, while the diminished original heals itself and grows a new tail. This process synchronizes with an increased metabolism and an increased power of resistance to poison vapours. Assuming these to be qualities of youth, then the regrowing fragment is again young. Similarly, we all know that ascetics and people who are spare in their diet often become curiously young in appearance. These are facts which suggest that creatures become younger in whole or in part by lying low for awhile, and that herein may be the clue to those curious processes of dying-back which occur during the hibernation of some animals and the winter changes in plants or trees.

These thoughts, arising from the many signs of spring, suggest a speculation that possibly the very early pre-differentiation stage of embryonic life in some complex organisms, where the individual is known to fail in evading senescence, may afford opportunities for rejuvenescence at the very start of life and a lessened risk of being born old. One draws from such an idea no dream of an *elixir vitæ* being extracted from an embryonic tissue; but it encourages the view that while habits age us, new work, new play and even new diet are but means of showing man that he is as young as his mind is, though he may be as old as his arteries. In any case, our efforts to stave off senescence may be rewarded by an evasion of senility, even though we find it difficult in these spring days to be either as gladsome as the finches or as rejuvenant as the newly-gilded larch or the freshly-purpled birch trees. If human life were longer, we might in time grow so used to the signs of spring's return that they gave us little pleasure; but although time flies quicker in later life than it does in childhood, a year remains a sufficiently large fraction of our whole experience for spring to keep for us until the end all its earliest fascination, and make us see the incongruity between what we are and what we might be. Perhaps, to enjoy fully the Lenten lilies of spring we must come to them with the spirit of Lent, but this is not given to us all.

Next, a turn in my walk brings me to a giant elm torn up and flung across the path. It is the aftermath of a recent gale, and near by, too, is a hornbeam resting against another with all the suggestion of a wounded man supported by a comrade. It is a picture of death in life and a reminder of those human derelicts who, but a mile or so away, are the piteous fruit of that other blizzard, a blizzard of iron and lead which sears, scorches, breaks and maims. It is difficult to suppress sad and suggestive thoughts, and yet the havoc wrought by Nature and by the fury of man will be repaired. But what years must pass by. Generations must come and go before another elm of the girth of that before me rears and holds its head. So, too, all those whose hearts are wounded by the red ruin of this war must pass to the great place of reunion ere mankind forgets the

anguish of this kind. None of us who are now alive will see it, but by the eye of faith. For us, it suffices to know that it will be, and we once more realize the unimportance of our own little span in the "unfathomable sea whose waves are years."

IX.

Returning from leave, I was sitting in the train just before its departure, noting the varied groups of people who had come to say good-bye to friends and relatives. Just outside my carriage were a couple who attracted my attention. They were a young pair and it was obvious that to both the parting was momentous. It was difficult to avoid hearing some of their words; the woman begged the man to take care of himself, not to be reckless, to remember all he was to her and the value of his life to others in the particular business of his life. What his reply was I did not hear, but doubtless the usual promise of a due regard for self-preservation, subject to the prior call of duty and honour. The whole incident was pathetic, and but one of many of the kind which have been enacted for many months on many railway platforms. The man got into his carriage and the train moved off. During the journey down to Folkestone, I found myself thinking of it all and recalled a farewell of my own and of my family to a fine young man at Peshawar city station, where he had come to say good-bye to us. It all came back, his cheery smile of confidence and deprecation at our parting bidding to take care of himself, if only for the sake of one of us. And then came the remembrance of the sequel, for he was killed in action within three months, whilst rescuing a wounded officer. It was difficult to avoid sad thoughts and serious reflection.

As I sat musing, the paradox presented itself that we wish or will for those whom we like and love that which we would prefer them never to will for themselves. Because the woman loved her man and I liked my friend we each willed their safety. If those two men had willed their own safety as ardently as the woman and I had wished and willed it on their respective behalfs, would they hold the same place in our estimations and be our heroes? One doubts it, and realizes that had they said, "I will take good care of myself for I perceive the loss you all would suffer if harm came to me," we should have felt in gaining our desire we had dishonoured the object of it. The fact is, the woman on the platform loved her man and I liked and gloried in my friend because we knew that each of those men despised or held at its true price the safety in which we would keep him. Both the woman and I had willed for our respective friend that which, when he willed it for himself, deposed him from our reverence and affection. We are here confronted with the fact that the view we take of our beloved or liked and the view our beloved or liked takes of itself are different. To us, the beloved must be preserved, but the beloved are not concerned with self-preservation and reserve for themselves a recklessness which we, on their behalf, would forbid.

It presents an interesting situation, and the difficulty is not lessened by our being obliged to admit that the safety which the woman and I desired

for our friends was not the last word of our minds, but that there is or was in us both an inward, deeper, subconscious will which consents to their sacrifice of themselves. In my own case, that subconscious will whispers now to me that had my dear dead friend hesitated to make the sacrifice, I should have revered him less. I do not know the subsequent history of the woman's man, but one is confident that, should he fail in making the great renunciation, her mental attitude would be similar to my own. If so, then the wills of our two friends were and are the same as that of the woman and myself. Even admitting this, a difficulty arises that when the woman and I have gone over to the side of our respective friends and consented to the temerity which destroys them, our other will, or the will for their safety and preservation, is not extinguished. It continues to utter a protest. Another argument comes along which says, that the sacrifice of the noblest and the best is a necessary factor in the progress of the world. To this the question arises, How many victims does the world require? Are there no limits and can self-sacrifice never be overdone? May not my friend have represented one more than was necessary and are the right ones always selected? To understand why the whole creation must suffer pain is not enough to reconcile us to the sorrow that actually exists. We must be satisfied that there is not one groan too many or too few, not one mistake in the persons selected for sacrifice nor in the time allotted for their pain. Between the abstract truth that someone must suffer and the concrete fact that my friend and no other has suffered, here is a wide gulf. Though convinced of the first, I am not reconciled to the second. Of the two wills within me, that which decreed the safety of my friend is far more assertive and argumentative than the other will which consented to and approved of his self-exposure to risk. If we ask a man why he risks a valuable life like his own, his reply will be, "I cannot do otherwise." If we turn back to ourselves, we find that this also is the attitude of our own second or subconscious will, and we say to ourselves 'I cannot do otherwise than consent to the course he has taken.' This brings us back then to the conclusion that, after all, my will and the woman's will were at one with my friend's will and her friend's will. Further, the conclusion is unavoidable that neither the woman and I nor our respective friends decided the question for ourselves. The decision had been decided by some Third Party, which we may call conscience or anything else we please. Much the same difficulty doubtless worried the Apostle when he asked himself why he in particular, and not one of the other Apostles, should have been selected as chief ambassador to the Gentiles. It is difficult to avoid making the same answer in our own case as St. Paul did, and say, "By the grace of God I am what I am." The truth seems to be that we have little say in the making of these decisions, and that is why we must and do say so little as to why and wherefore. There is comfort in the thought, because it confirms the presence of the power within us of a beyond-self, and it explains the instinct we possess that it is good to give all when a higher than self demands it.

REPORT OF A BASE LABORATORY IN MESOPOTAMIA FOR 1916, WITH SPECIAL REFERENCE TO WATER-BORNE DISEASES.

BY CAPTAIN T. K. BONEY.

Royal Army Medical Corps.

CAPTAIN L. G. CROSSMAN.

Royal Army Medical Corps.

AND

LIEUTENANT (U.L.) C. L. BOULENGER.

THE following is a short account of the results obtained in the laboratory at — British General Hospital, dealing with the diseases prevalent in Mesopotamia among the troops during 1916. A few brief remarks as to climate and general considerations may be of service to a preliminary understanding of the prevailing conditions there.

The months of January, February and March constitute the period of the rains. During the whole of this time the river is rising, and continues to do so until about the middle of May, after which it gradually falls, the lowest level being reached by about the middle of October. During the first three months the temperature is never very high during the day time—the average daily maximum being about 66°, 70°, and 78° F. respectively for these months. There is a considerable drop at night, though it is rare for the thermometer to fall much below 40° F. April to September constitutes the hot weather period, the average daily maximum being highest during July. In July, 1916, this daily average, taken under the prescribed conditions of shade, etc., was 110, but under the conditions in which men frequently lived, it was certainly much higher.

The first part of the hot weather is characterized by great moisture, partly owing to the large amount of flooded country produced by the swollen river overflowing its banks, and partly to the frequency with which the wind is in a southerly direction at this time. About the middle of June the prevailing wind changes to the north, causing great improvement in the climatic conditions, and continues fairly regularly from this quarter for six weeks or more. In 1916 this north wind was late in its arrival, and did not commence to blow until the end of the third week in July.

Flies begin to multiply in March, and become a great pest in April and May, then disappearing rapidly as the heat increases.

The low-lying swampy ground provides a breeding place for mosquitoes although, as pointed out by Major Christopher. I.M.S., owing partly to its being tidal, and from other causes, it is not as well adapted to this purpose as might at first sight seem to be the case.

Under these conditions it is not surprising to find that malaria and the water-borne diseases should account for such a large part of the sickness

among the troops. The latter group showed a steady increase from March onward, reaching a maximum in July and August.

The great bulk of the material sent for examination was supplied by this hospital; a certain amount, however, came from other units in the vicinity not supplied with fully equipped laboratories. This was chiefly of the nature of blood cultures and agglutination reactions.

ENTERIC GROUP DISEASES.

A chart showing the monthly incidence of enteric group disease, as diagnosed by blood culture in this laboratory, is shown at the end of this section. Although over 650 cases have been diagnosed by all methods during the year, only 21 per cent were found to be true typhoid, while 65 per cent were due to *Bacillus paratyphosus* A.

As far as we can determine, paratyphoid B fever had not been diagnosed in this country prior to the arrival of the — Division in March. We (K.B.) had not isolated the organism, and had failed to find agglutinative evidence of its presence in the blood; and we believe our predecessor had met with a like result. On the arrival of the — Division many cases of enteric and both paratyphoid fevers were admitted from the transports, and, apart from agglutinative evidence, *B. paratyphosus* B was isolated by blood culture on two occasions during this month from among these cases.

It would appear that an orderly nursing in the paratyphoid ward of this hospital was the first case of paratyphoid B infection arising in this country to be diagnosed as such. During April a few cases (five) continued to be diagnosed, and an increase occurred in May which reached its maximum in June. In fact, more than fifty per cent of all the cases diagnosed occurred during these two months, blood cultures being positive on several occasions. Since then the organism has never been isolated from the blood, and its incidence, judged by agglutination tests, has fallen to four or five cases a month. Nearly all of these latter came from the Euphrates area. The rise of paratyphoid A fever during the hot weather, reaching its maximum in September, is also shown on the accompanying chart.

Investigation was carried out under three headings:—

- (a) Isolation of the organism from the blood.
- (b) Isolation of the organism from the stools.
- (c) Agglutination reactions.

Urine was only examined on five occasions with a negative result in each case. Blood cultures have been made systematically on all possible cases. None were made in January or February, as no acute cases in early stages of the disease were seen then.

Stool examination was commenced in January, and carried on intermittently until the end of April. During the hot weather it practically ceased, and was resumed again at the beginning of October. It has never been done systematically in all cases, but was chiefly relied upon in those seen too late for blood culture, in which agglutination reactions were likely to be modified by reason of inoculation with T.A.B.

Agglutination reactions were performed on all cases not coming in previous groups.

Blood Cultures: Technique.—Five cubic centimetres of blood were withdrawn from a vein and inoculated into ten cubic centimetres pure ox bile. This latter could always be obtained from the slaughter-house, and proved a very satisfactory medium. As a general rule, blood was not taken before the fourth day, nor after the tenth. Relapses, in cases not previously diagnosed, were made an exception; and in many such a positive result was obtained late in the disease.

After incubation for twenty-four hours, and at the end of every subsequent twenty-four hours for four days, subcultures were made into mannite peptone water. As soon as evidence of acid formation was seen, an agar slope was inoculated from this tube, and also a broth tube. This was examined for motility, and the slope was emulsified at the end of twenty-four hours, and tested against high titre serum in dilutions up to 1 in 800 or 1 in 1,600. Usually a dilution of 1 in 800 with the serum was considered sufficient.

Identification was thus based on:—

- (1) Reaction and amount of gas, if any, in mannite tube.
- (2) Character of growth on agar and motility.
- (3) Reaction to specific serum.

At first other sugars were used, but the purity of some of them was not above suspicion, and for the identification of an organism isolated from the blood-stream, their use was not deemed essential as a routine measure. The high titre serum was of Lister Institute manufacture, and was the ultimate criterion of specificity. It was kept in the ice-chest during the hot weather. The sugars, dulcitol, lactose, glucose, and salicin were employed if any irregularity was observed in (1) or (2), or if complete agglutination in dilution 1 in 800 did not occur in two hours at 37° C. If excessive gas was observed in the mannite tube, or early formation of gas, plating on MacConkey was always done to avoid masking of E. group organisms by contamination.

The behaviour of the paratyphoids in mannite peptone water differed markedly. As a rule *paratyphosus* B formed acid and gas vigorously—usually to the extent of about one-third of the Durham tube in twenty-four hours.

Of ninety-five strains of *paratyphosus* A there was no gas formation at all in twenty-eight. In sixty-four, there was slight gas formation at the end of twenty-four hours, very often merely a bubble. At the end of forty-eight hours this would have increased to about one-third of an inch. Two others showed marked gas formation, and in one the gas more than half filled a Durham tube. These latter gave the ordinary fermentation reactions of the group.

A certain number of anomalous organisms were isolated from time to time, which could not be referred to any group, although from the delicate

nature of the growth and other reasons, they did not appear likely to be contaminations. Two were submitted to Parel Laboratory for animal inoculation and further report, and a good many others could not be worked out for want of time.

In four cases organisms giving all the sugars reactions of the paratyphoid group were met with, but which did not agglutinate or only did so very slightly. The figures dealing with positive results do not include any of these. On one occasion hæmiculture yielded an organism of *Fæcalis alcaligenes* group.

At the beginning of October, it was arranged to issue for blood cultures small sealed bottles of ox bile to other units on application. The result was communicated by telephone, but percentage of positive results compared with those done in this hospital has been very small. This may in part be due to bad selection of cases by medical officers, but may also be accounted for by delay in reaching the laboratory.

	B.G.H.	Other sources	Totals
Total number of cultures made ..	352	32	384
Positive to <i>B. typhosus</i> ..	21	1	22
„ <i>B. paratyphosus</i> A ..	93	3	96
„ <i>B. paratyphosus</i> B ..	7	0	7

Inagglutinable strains resembling paratyphoids in all sugar reactions, 4; and *B. paratyphosus* B more closely in respect of gas formation.

The figures show that 32·6 per cent of positive were obtained of all cases, whereas taken separately only 12 per cent of outside cases yielded positive results as against 34·4 per cent of cases from this hospital.

The relative incidence of the members of the group deduced from these figures is: T., 17·6 per cent; A., 76·8 per cent; B., 5·6 per cent. The figures for paratyphoid B are low when compared with the agglutination results. It is probable that the inagglutinable strains, had it been possible repeatedly to subculture them and test them against the serum, would have been found to agglutinate and should also be included among them.

Further, the shorter duration of the bacillæmia in paratyphoid B infections compared with *B. typhosus* and paratyphoid A infections has been reported upon, and in cases received at the end of the first week or later, for this reason alone the diagnosis of the infection by blood culture would not be on all fours with diagnoses made in the same way in the case of other members of the group.

Nevertheless the duration of the bacillæmia, speaking of the group generally, is in some cases strikingly long, and in most cases would appear to last well over a week.

Analysis of 87 cases of continuous fever, all yielding a positive blood culture of an enteric group organism, gives the following result.

Day of disease :	3	4	5	6	7	8	9	10	11	13	15	19	30
Number of positives	1	6	12	12	18	16	9	8	1	1	1	1	1
Percentage of total blood cultures	16·5	40	28	25	36·7	37	25	29·6					

During relapses successful cultures were made on the sixteenth, twenty-first, twenty-third and fortieth days of illness, and in a few other cases in which the duration of the illness was uncertain.

In one case *B. paratyphosus* B was isolated from the blood and *B. dysenteriae* Flexner from the stools.

Stools.—The difficulties in the way of systematic stool plating were considerable, principally owing to the climatic conditions. Apart from the fact that media for plates all had to be prepared and sterilized in the room where microscopic work was going on, thus adding considerably to the already high temperature, large quantities of medium could not be prepared as moulds, etc., grew very rapidly. For three months, plates would not set unless placed in the ice-chest, already overcrowded, and of construction not ideal for the accommodation of a plate level in the presence of rapidly melting ice. When ready, plates had to be used the same day to give good results and the fitting in of the preparation of the plate with the arrival of the stool at the laboratory frequently left much to be desired. As a result, the method was only followed in a few special cases, reliance being placed on blood culture and Widal tests for the diagnosis of members of the enteric group.

Of 108 examinations, *B. typhosus* was recovered five times and *B. paratyphosus* A eleven times. *B. paratyphosus* B was never isolated.

Technique.—At first the time-honoured method of direct plating on MacConkey was used. Subsequently the modification of Browning's original brilliant green method as recently described by Leitch (*Brit. Med. Journ.*, September, 1916) was tried. The difficulty here seemed to be to hit off the right length of time in which to allow the brilliant green to act before plating. Varying periods of from ten to twenty hours were tried without much obvious advantage, and finally direct plating on MacConkey was again reverted to. It would appear in any case that the method is best suited to a search for *B. paratyphosus* B, too great inhibition being exerted on the more delicate growing *B. paratyphosus* A. At the end of twenty-four hours, suspicious colonies were fished, examined for motility, and the sugar reaction tested. The specific serum test was then applied as for organisms isolated from the blood.

Agglutination Tests.—The bulk of E. group cases have been diagnosed by this method. Although admittedly the least desirable means, this was only to be expected in a hospital receiving so large a number of its cases from up-river, and relatively so few direct admissions. In these late cases, recovery of the organism from the stool or urine is the only alternative, but the difficulties in the hot weather and the length of stay in hospital required, frequently renders such search impossible. Recourse therefore must be had to agglutination tests, and in T.-inoculated persons the error is probably not very great—perhaps ten or fifteen per cent. In such cases, marked agglutination to either A or B has been taken as presumptive evidence of infection by the corresponding organism, even if the T. titre was also high. The possibility of mistaking a true T. infection for A or B

under these conditions would appear remote, since it is generally agreed that T. infection produces as a rule little group agglutination for A or B, whereas in A or B infections usually the first noticeable change is a rise in the titre to be *B. typhosus*. It is much more necessary therefore to be on guard against diagnosing as a T. infection one which is really due to A or B, the true nature of the case becoming apparent later on by the appearance of agglutinins for these organisms, generally by the end of the third week.

In this way diagnoses made by us on the presence of fairly high T. agglutinins during the second week have in a certain number of cases been altered after subsequent agglutination tests have been performed. It is probably inevitable that a certain number originally so diagnosed have escaped further observation and have helped wrongly to swell the typhoid agglutination figures, although possibly not many, as a comparison of percentages with blood culture percentages will show. The short stay in hospital of many cases received from up-river prevented multiple agglutination tests being done as a routine measure. It was done however in a great number of cases, if considered necessary. In uninoculated persons and in a *certain number* of T.-inoculated persons it was thought that one Widal would suffice, if taken sufficiently late in the disease. A difficulty was met with occasionally when successive agglutination tests showed progressively increasing titre to all three organisms. In some of these in which the B titre was a good deal higher than that of A a diagnosis of paratyphoid B was made; but generally, in such, no attempt was made to diagnose specifically. Even in these cases such agglutinations are at least sufficient to indicate the presence of E. group disease.

To warrant a diagnosis of true typhoid in a T.-inoculated person, we required a high or rising titre to T. with none to A and little or none to B. With the method used, a titre of 1 in 320 was generally considered sufficient unless inoculated within eight or nine months.

The recent extensive introduction of T.A.B. has greatly impaired the value of agglutination tests in our opinion. In the majority of such cases it would appear impossible to attempt an accurate diagnosis by such means, except possibly by an elaborate series of tests, spread over a considerable period of time. At a base hospital on active service this is not practicable.

Stool examination, uncertain as a means of detecting the "carrier," is even more uncertain as a means of diagnosing large numbers of acute cases during a rush of work.

In this connexion it may be pointed out as a causal factor that whereas the suspected convalescent "carrier" can be purged with impunity, a like freedom of treatment is seldom desirable in patients during the acute stages. In the latter case one has to work with stools that may have lain in the large intestine many hours, obviously detrimental to a successful result.

Possibly more energetic hæmoculture in all suspected early cases may help in part to solve future difficulties in diagnosis.

Agglutination Technique.—The strains used were all reliable ones. Two were brought from France and the third was obtained from India. Carbolized agar emulsions were made from subcultures, and retained their agglutinability through the hot weather. At the beginning of September the *paratyphosus* A strain died out, and so all three were replaced by strains brought from Egypt by Lieutenant-Colonel Ledingham and which had been used there as standard. These have remained in use since with satisfactory results.

In performing the tests, the dilutions were made on a glass plate ruled with grease pencil, then drawn up into lengths of glass tubing of bore about three millimetres and incubated for eighteen hours at 37° C. when the reading was made, using a + 12 lens.

The total number of agglutination tests made during the year was 1,283, and the number of diagnoses made 520 or 40 per cent. Of these 520, enteric fever accounts for 113 = 21 per cent, paratyphoid A for 326 = 62 per cent, and paratyphoid B for 82 = 16 per cent.

Inoculation.—Details of inoculation have been kept on all cases investigated during the year and a glance at the results is of interest. Only those dealing with cases in which the organism was obtained from the blood will be considered.

1st Series.

PATIENTS EITHER INOCULATED OR UNINOCULATED WITH OLD T.V.

<i>B. typhosus</i> ..	{	Never inoculated	21	}	22
		Never or more than eighteen months ago	16		
		Inoculated within eighteen months ..	6		
<i>B. para. A</i> ..	{	Never inoculated	18	}	83
		Never or more than eighteen months ago	30		
		Within eighteen months	49		
		Not stated	4		

In the above cases, the inoculation is either definitely stated to have been T.V. or took place at such a date that would exclude the possibility of T.A.B. Apart from the fact that cases of enteric fever only form 20 per cent of the total, it shows that of these only 27 per cent had received inoculation within one and a half years, and 50 per cent had never been inoculated at all: remarkable figures when it is considered how greatly in British troops the inoculated must outnumber the uninoculated, and therefore the correspondingly greater number of the former who are exposed to infection.

In cases of *paratyphosus* A, against which it would hardly be expected to give any protection, the incidence among the inoculated and uninoculated is seen to follow this "mass" factor just referred to, in the proportion of sixty-one to eighteen.

Figures for T.A.B. are of course only available over a short period. I give figures of all cases diagnosed by blood culture, since September 1. The total number of these is fifty-three, and includes a certain number of T.-inoculated individuals already dealt with under that section.

2nd Series.

<i>B. typhosus</i>	{	Never inoculated or not within eighteen months ..	7	}	9
		Inoculated T.V. within eighteen months ..	2		
		Inoculated T.A.B.	0		
<i>B. para. A</i>	{	Never inoculated or inoculated with old T.V. ..	31	}	44
		Inoculated T.A.B. within six months ..	10		
		Inoculated in May and June, 1916, most probably T.A.B.	3		

These figures deal with small numbers of course, but inasmuch as they are based on blood cultures they are accurate; and if they show anything they show the protective value of the old typhoid vaccine.

With regard to T.A.B., if its value be as great, it is a little surprising to find the incidence of *paratyphosus A* so high in men inoculated within six months of the onset. As a matter of fact nearly all these cases occurred within four months of inoculation, and some a good deal less than this.

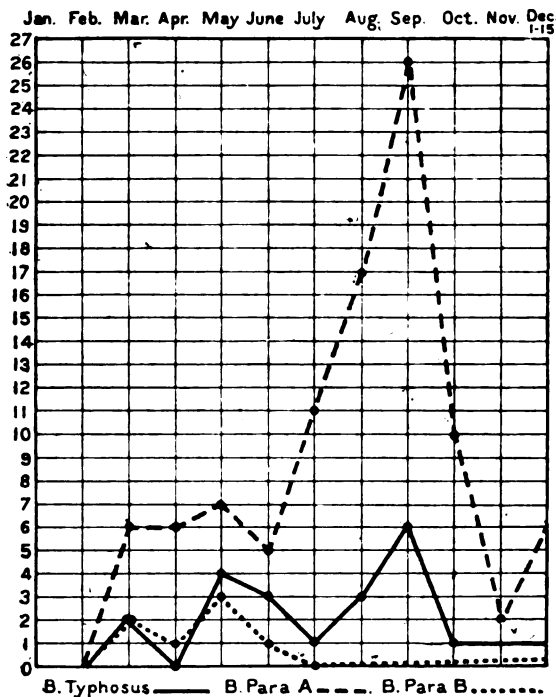


Chart showing the monthly incidence of enteric group disease by blood culture.

SUMMARY OF ENTERIC GROUP.

Total number of cases diagnosed: January 1 to December 31, 1916 ..	661	{ T. .. 139
Organism isolated in 141:—		{ A .. 433
		{ B .. 89

Blood .. 125	{	T. ..	22	= 17.6 per cent total positives =	5.7 per cent total cultures.
		A ..	96	= 76.8	" " " "
		B ..	7	= 5.6	" " " "
Stools .. 16	{	T. ..	5		
		A ..	11		
		B ..	0		

Diagnosed by agglutination:—

520	{	T. ..	112	= 21 per cent total positives =	8.9 per cent total agglutination.
		A ..	326	= 62	" " " "
		B ..	82	= 15.4	" " " "

CHOLERA.

Cholera was first noticed among the troops towards the end of April. Four or five suspected cases arrived at this hospital from up-river on April 30. A hasty microscopic examination of the stools, all of typical appearance, showed the presence of vibrios having the morphological character of cholera; a provisional diagnosis was made and the cases were transferred to a section of the isolation hospital prepared for them. From this time on, there was a steady stream of cases during the hot weather. The outbreak never reached alarming proportions and gradually died out by the end of September.

Incidentally, a mortality of about forty per cent was recorded.

A large number of stools were examined in May and June (about 120) for *V. cholera*, many of which were positive, but unfortunately the records have been lost. Since then seventy-one stools were examined with positive results in twenty-eight. In forming a positive diagnosis, the following points were taken into consideration :—

(1) Naked-eye appearance of the stools.

(2) Characters of smear stained with dilute carbol-fuchsin, i.e., presence of vibrio forms, presence of spirochaetes (*S. eugyrata*), etc. Although the circumstances of the occurrence of the latter in the stools are but imperfectly understood, in actual practice it was found that in smears showing them a vibrio could generally be isolated in peptone water from the stools: Stools containing them were therefore regarded with grave suspicion, and a report given accordingly before waiting for the result of culture.

(3) Culture in peptone water and examination of the top layer for vibrios after eight to ten hours' incubation. The use of Witte peptone, of which we always had a supply, was found invaluable in this connexion, and frequently gave positive results when other good peptone, although sugar-free, was negative. The formation of a surface pellicle did not seem to be very constant.

(4) Reaction against specific high-titre serum. This was always done microscopically by hanging drop. Immediate complete agglutination in dilution of 1 in 200 or 1 in 400 was taken as positive.

(5) Cholera-red reaction. This was done on every case at first, but was later given up owing to its uncertainty in cases which otherwise conformed to type. The hæmolytic test was not done in any case.

Of the twenty-eight cases in which a vibrio was isolated, twenty-two were diagnosed on the growth of a vibrio in peptone water, which was morphologically *V. cholera*, and which was agglutinated in the manner specified. In the remaining six no agglutination occurred.

THE DYSENTERIES.

Whether or no amœbic dysentery is endemic in this country we do not know, yet certainly it has been responsible for a great deal of sickness among the troops here throughout the hot weather. Of even commoner

occurrence has been the bacillary form of the disease according to our own figures. Speaking generally of cases with dysenteric symptoms, the maximum of the curve of incidence was reached in August and September, as in the case of enteric group disease, after which it gradually fell again.

It is to be regretted that these cases were not examined systematically from the beginning, but pressure of work and the trying conditions of heat prevented this. A small number of stools were plated (fifty-nine), all of them containing blood and mucus. *B. dysenteriae* Flexner was isolated in seven, and *B. dysenteriae* Shiga in two. Microscopical examination of eighty stools also containing blood and mucus showed *E. histolytica* in eleven.

By the addition to the laboratory staff of Captain Crossman, R.A.M.C., and Lieutenant Boulenger, a detailed examination of all cases became possible. This was undertaken at the instigation of the Medical Advisory Committee, and was commenced in September. The protozoological findings were the work of Lieutenant Boulenger, and a short account of the work is appended by him.

In this way the stools of 890 cases of intestinal disorder were investigated during the last four months of the year.

These cases fall into two groups:—

- (1) Cases of acute dysentery.
- (2) Cases in which some diarrhoeal symptoms were present, and in which there may or may not have been a history of a previous acute dysentery.

This latter group doubtless included a great many cases of ordinary simple diarrhoea.

The method adopted was briefly as follows:—

- (1) Microscopical examination was first made on every case, and the protozoological findings noted.

Those containing blood and mucus (i.e., group I, acute dysentery), and not showing the presence of *E. histolytica*, were then plated.

- (3) Stools containing no blood or mucus were not plated.

This was the general procedure, from which there were a few exceptions made.

(a) A small number (twelve) containing blood and mucus, in which *E. histolytica* had already been found, were also plated.

- (b) Nineteen stools containing no blood or mucus were plated.

The results obtained will be considered according to this grouping:—

Group I: Acute dysentery, i.e., cases passing blood and mucus in stools. The number of such cases was 309.

Microscopic Examination.—*E. histolytica* 80 = 26 per cent. These are considered in the section dealing with the prozoological findings. Of the remainder 209 were plated with the following result:—

<i>B. dysenteriae</i> ..	Shiga	65	} = 108
	Flexner	..	..	..	..	38
	Shiga and Flexner	..	..	..	..	5
	Negative	..	..	..	..	101

Thus 108 cases, or 51·7 per cent of those submitted to bacteriological examination, were proved to be due to infection by *B. dysenteriae*; and the relative incidence of the two forms of the disease will be: amœbic 26 per cent, bacillary 35 per cent, of the total number of cases examined.

Two cases of mixed amœbic and bacillary infection were noted, viz., (1) *E. histolytica* and *B. Shiga*; and (2) *E. histolytica* and *B. Flexner*.

There still remains 39 per cent of acute cases in which the causal agent was not determined. A bacillus of the Morgan No. 1 group was isolated once, but it is possible that if repeated examinations had been made a certain further proportion of these undiagnosed cases would have been cleared up. "Repeat" examinations for protozoa on negative cases were made a great number of times, but it was of very rare occurrence that *E. histolytica* was noted in any of these subsequent examinations. On the other hand, only twelve cases were plated a second time, the first occasion being negative, and in three of them a bacillus was isolated (*Shiga*). We are, therefore, inclined to think that the undiagnosed cases were chiefly of bacillary nature, either due to one of the recognized strains which a subsequent plating might have revealed, or else caused by other bacillary agents of hitherto unrecognized specificity.

From an examination of the above figures, the Medical Advisory Committee reported as follows:—

"It is thus apparent that bacillary dysentery is the predominant type in the Mesopotamian area (as in other war areas), and there is little doubt that, had the cases investigated been in the main local admissions instead of transfers from up-river, the proportion of bacteriologically proved bacillary cases would have been still higher."

Technique.—A small portion of mucus was emulsified in sterile saline, and a couple of large loopfuls transferred to a MacConkey plate, a piece of capillary tubing bent at right-angles being used as a spreader. After eighteen to twenty hours' incubation suspicious colonies were picked off, about three from each plate—and each one inoculated into mannite peptone water and broth. The broth tube was examined for motility, and an agar slope was inoculated from the broth or mannite tube, if no gas formation had taken place in the latter. The following day the agar slope was emulsified and tested against high-titre serum.

The inoculation of a broth tube was frequently omitted later on, as it was found that examination of the mannite tubes for motility could be relied upon, if not done later than eight or nine hours after inoculation. In the case of the non-acid forming *Shiga* group, the examination could be made as from a broth tube.

The reaction against specific high-titre serum was done macroscopically in every case, using the technique adopted in all other agglutination tests, and already described. The titre of the serum was rarely higher than 1 in 1,000 and was frequently not more than 600 or 800; and it was always found to give more marked agglutination against organisms of the *Shiga* group than against those of the *Flexner* group.

Complete agglutination in a dilution of 1 in 200 at 37° C. was accepted as positive in the case of an organism which otherwise satisfied the requirements. In the majority of cases tried, the organisms have agglutinated up to the full titre of the serum, especially those of the Shiga group.

The sugar reactions at first, after the primary differentiation by mannite, were not fully investigated. A great many later strains, however, have been kept and the sugar reactions tested against glucose, maltose, saccharose, inulin, dextrine and lactose, and subsequently against dulcitate, salicin and adonite. Organisms of the Flexner group all produced acid in mannite, maltose and glucose, usually in twelve hours, and remaining acid up to five to seven days, after which observation ceased. In dextrine, acid formation was usually slight though definitely present. Most of the strains tested produced acid in saccharose within twenty-four hours. One subsequently became neutral, and in two more no change took place at all; in lactose there was no change, nor in salicin, inulin, adonite and dulcitate.

Of the Shiga group, all produced acid in glucose, in maltose, acid at first becoming neutral after four or five days, or less definitely acid; in saccharose, usually no change, but acid formation took place in two at the end of twelve hours; no change in mannite, lactose, dulcitate, salicin, inulin, dextrine and adonite.

A certain number of strains were obtained in which agglutination was incomplete, very slight or absent. Some of them were put through other sugars, glucose, maltose, saccharose, and dextrine, but whether they conformed to type in these reactions or not, they were not regarded as true strains. In such cases, a diagnosis of "bacillary dysentery" (mannite-fermenting group), or the reverse, was returned. None such are included in the above figures. The medium used for plates was MacConkey; Conradi-Drigalski was used earlier in the year, but was given up in favour of the former.

Group II: Chronic dysentery and diarrhoeal conditions, i.e., stools containing no blood or mucus.

It has already been mentioned that nineteen stools containing no blood or mucus were plated.

They were all negative.

PROTOZOOLOGICAL FINDINGS IN GROUPS I AND II.

From the beginning of September, 1916, onwards the stools of all patients suffering from dysentery and allied intestinal disorders were examined for pathogenic and other protozoa; this section furnishes a preliminary account of the findings from that month to the end of the year.

During this period nearly 1,300 stools were dealt with, representing 890 separate cases—all British patients.

With few exceptions the cases were patients resident in the hospital; a uniform method of collecting specimens was therefore found desirable and was briefly as follows:—

Bed-pans containing the fæces were taken by the ward orderlies to a small shed conveniently situated and set apart for the purpose. The contents were inspected at intervals during the day and the macroscopical characters—presence or absence of blood or mucus, colour, consistence, etc., noted. Small samples were taken to the laboratory in corked tubes and examined microscopically before being passed on to the bacteriologists. By this method perfectly fresh specimens were dealt with, this explaining the rather high percentage of free living organisms, e.g., free amoebæ and flagellates, observed.

Smears from the fæces were examined in salt solution (warmed to blood temperature when necessary during the winter months) and Weigert's iodine solution, according to the method recommended by Lieutenant-Colonel C. M. Wenyon, R.A.M.C., in his recent publications on the subject.

Entamæba histolytica.—Of the 890 cases examined 142, or approximately 15·9 per cent, were found to be passing the pathogenic *E. histolytica*, either in the free living or encysted condition.

The 890 cases naturally included a large number of convalescent dysentery patients as well as a few cases of simple colitis and diarrhœa; the acute cases of dysentery (i.e., in whose stools pus cells and red blood cells were found) numbered 309 and *E. histolytica* was found in 80 of these.

It is therefore possible to state that over a quarter (25·9 per cent) of the acute dysenteries at this hospital during the last four months of the year were of amœbic origin.

Non-pathogenic Amœba.—The non-pathogenic *E. coli* was met with in 162 cases, or about eighteen per cent of the total number. The only other parasitic amœbæ noted were small forms of the *limax* type which occurred in four cases; these are probably to be referred to the species *E. nana* recently discovered by Lieutenant-Colonel Wenyon in Egypt.

Flagellates.—*Lamblia* (*Giardia*) *intestinalis* was found to occur frequently and was recorded in eighty-eight, or nearly ten per cent of the cases; the pathogenicity of this species has been much discussed; there seems, however, little doubt that certain persistent diarrhœas were due to its presence in the intestines.

Trichomonas intestinalis and *Tetramitus* (*Macrostoma*) *mesnili* were also occasionally met with, occurring in 8·1 and 5·7 per cent of the cases, respectively.

Coccidium.—A *coccidium* of the *isospora* type was found in seven cases; no special symptoms of coccidiosis were, however, noted in any of these.

TABLE SHOWING THE OCCURRENCE OF PARASITIC PROTOZOA IN 890 CASES OF INTESTINAL DISORDER.

	Number	Percentage
<i>Entamæba histolytica</i>	142	15·9
„ <i>coli</i>	162	18·2
„ <i>nana</i>	4	0·45
<i>Lamblia intestinalis</i>	88	9·9
<i>Trichomonas intestinalis</i>	72	8·1
<i>Tetramitus mesnili</i>	52	5·7
<i>Coccidium</i> (<i>Isospora</i> sp.)	7	0·8

MALARIA.

In January benign tertian parasites were found in only 11 cases and subtertian in 1, out of a total of 90 examinations. An increase was not noticeable until May when the number of examinations had risen to about 150 with about sixteen per cent positive. In July, 50 positives were recorded among a total of 248 and of these 44 were benign tertian and 4 subtertian. The remaining two appeared to be the quartan variety, a marked chromatine band being present.

Subsequently to this, the level remained fairly constant with a slight drop in August. In November the subtertian had increased and were in the proportion of one to three of all cases diagnosed.

For the months January, February and July to December 15, i.e., seven and a half months, the total figures are 1,477 examinations with 260 positive = 18 per cent. Of these 260, 40 = 18 per cent were subtertian. Actual figures for the remaining months, March, April, May and June are not available. The monthly average was 200 per month with seventeen per cent positive. The total number of slides thus examined was between 2,200 and 2,300 during the year.

RELAPSING FEVER.

Forty-seven cases were diagnosed by finding spirilla in the blood. All of these cases except two arrived with the — Division from Egypt and were men of the — Regiment who had all travelled together in the same ship to Mesopotamia. The two cases excepted were officers who had been doing duty at a Turkish prisoner's camp, where a good number of cases had occurred among the prisoners. Only one case terminated fatally. Strict isolation and disinfection of kit succeeded in limiting the epidemic to this one regiment, and in eradicating it in less than a month. Apart from this outbreak, *S. recurrentis* was not reported in this laboratory during 1916.

JAUNDICE.

Blood cultures were done on five cases of jaundice with low pyrexia. All were negative.

CEREBROSPINAL FEVER.

The meningococcus has been found in the cerebrospinal fluid of six cases, one of which occurred outside the hospital (Civil Surgeon's case). It could not be cultivated on blood-smeared agar on any occasion, although once or twice it was present in enormous numbers.

In every case the diagnosis was based upon the polymorphonuclear nature of the exudate, and the presence of a Gram-negative diplococcus morphologically resembling the meningococcus, a certain number of which were inside the cells.

During October, the throats of fifty-one healthy N.C.O.s and men of the Australian Wireless Section were examined for the presence of the meningococcus, with negative results.

DIPHTHERIA.

This disease has not been of unfrequent occurrence. Altogether twenty-two cases have been diagnosed, but the majority of these have been in men of the same regiment and occurred during August and September. During the hot weather, when serum media were difficult to prepare, and still more difficult to keep, many successful inoculations were made on the white of a recently hard-boiled egg inverted in a urine specimen glass containing a little water to keep it moist. While not growing quite so readily as on serum, this method proved of considerable practical value.

ORIENTAL SORE.

Although smears from scrapings of suspected sores have been examined from time to time, no Leishman bodies have been seen in any of them.

PLAGUE.

Only on one occasion has material been sent to the laboratory from a case of suspected plague and the report was negative.

A certain number of rats have been examined however, thirty-eight in all, since the middle of October. Only one of these was caught in a trap. The others were either killed by sticks, or shot, with the exception of two which were found dead. (A great many others, not included in the above, were found dead, but were too mummified or decomposed to permit of satisfactory examination.) Six of the thirty-eight showed plague lesions, and were seen by the officer on special plague duty, Major Kunhardt, I.M.S. *B. pestis* was isolated from the heart blood in all of them.

VACCINES.

Prophylactic vaccines were made for cholera and enteric group. The preparation of a cholera vaccine was undertaken in May. It was an unheated agar emulsion killed by one per cent phenol and in which four strains were used in the manufacture, three of which were local, and the fourth Indian. Fifteen thousand doses were issued, the bacillary content being 2,000 million per cubic centimetre.

In concluding this report we are desirous of expressing our thanks to Lieutenant-Colonel Woodside, R.A.M.C., our Commanding Officer, for the facilities which he has always placed at our disposal for carrying on the work. To the Medical Advisory Committee, and in particular to Lieutenant-Colonel Ledingham, R.A.M.C., and Lieutenant-Colonel Wenyon, R.A.M.C., we should like to acknowledge our gratitude for their very valuable advice and help during their stay in the country; to Lieutenant Baillie, R.A.M.C., whose work in the laboratory during the most trying part of the hot weather was much appreciated, and to Assistant-Surgeon Ireland, I.S.M.D., and Corporal Muggleton, R.A.M.C., the latter for his work in connexion with plating and the collection of material in dysentery cases, the great part of which was done by him.

A TIME-GOVERNED SLIDE METHOD FOR THE AGGLUTINATION TEST ON A SERIES OF MICROBIC EMULSIONS.¹

BY CAPTAIN (LOCAL MAJOR) W. BROUGHTON-ALCOCK.

Royal Army Medical Corps (S.R.).

THIS method for the rapid detection of agglutinins is one which permits of the simultaneous examination of several standard emulsions of micro-organisms and of the determination of results in three or four minutes. It was demonstrated and reported at the Military Hospital for Infectious Diseases in France and at the Pasteur Institute, Paris, in February, 1915, and later in London, and at the Army and Naval Central Laboratories in Italy. Extended details of the method, its application and results, were forwarded to Army Headquarters in May, 1916. Army bacteriologists have for some years (since 1906) used the method of placing drops of high titre sera diluted 1/100 on a microscope slide and making emulsions in such drops from cultures or colonies of bacteria to be tested; the results being observed by the naked eye. Similarly unknown sera have been tested in series on slides against known bacteria.

Many earlier workers also have used low dilutions of blood sera or of blood itself with one emulsion, and have used slides for observing the bacillary clumping, usually under the microscope. It has also been noted that agglutination is greatly facilitated by rotation of the slide on which the mixture of the serum and emulsion are placed; the contained organisms come into frequent contact with one another and the homogeneity of the serum dilution is maintained by movement.

The following is a simple practical macroscopic method whereby a measure of the agglutinin content of serum can be obtained and serial emulsions can be used—i.e., the serum can be tested against emulsions of a number of different organisms at the same time. By this method, as will be shown subsequently, the specific agglutinin can not only be detected, but can be distinguished from any co- or hetero-agglutinin, which may also be present in the serum, and possible errors of diagnosis by single emulsion examination can thus be avoided. As an example it may be here stated that I found, and by the absorption test confirmed, that a patient suffering from undulant fever may develop marked hetero-agglutinin action for *Vibrio cholerae*.

I have also endeavoured since 1912 to establish the principle that the agglutinin action can be measured by the time taken for agglutination to appear in fixed dilutions of serum.

The specific agglutinin in a given serum dilution acts more quickly

¹ NOTE.—This paper was received for publication April, 1916, but was held over in response to a request from the author.

than the co- or hetero-agglutinin that may be associated with it, when the stock emulsions are employed.

Lieutenant-Colonel Harvey (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, 1911) noted the more rapid action of the specific agglutinin in cases of infection with *Bacillus paratyphosus* A. In the *Lancet*, September 19, 1914, I reported some observations made when testing sera, after inoculations with some strains of *B. paratyphosus* B. They clearly showed, especially with regard to two of these strains, the earlier development in the serum and more rapid action of the specific agglutinin on the strain inoculated. It may be that this quality of a specific agglutinin can be utilized in the classification of types of micro-organisms of the same group.

When agglutination tests are to be carried out at intervals during the progress of a case and the results compared in time measurements, the serum requires to be so far diluted that agglutination will not be instantaneous in order that a measurement may be made of the time at which agglutination appears (i.e., thirty seconds or longer). An increase or decrease in the agglutinin content of a serum can be detected by the decrease or increase of the time taken for the agglutination of the emulsion in this dilution. Further, by testing on a slide drops of increasing dilutions of a serum with an emulsion the highest dilution that produces agglutination thereof in a specified time limit can be determined. The reading of results is made at the end of three or four minutes. Interval examinations are carried out on similar lines and the results are compared to detect any rise or fall of an agglutinin action.

The dilution of the serum employed for an initial agglutination examination, in the case of *B. typhosus*, *B. paratyphosi* A and B, *V. cholerae*, *Micrococcus melitensis* and *M. paramelitensis*, 1 in 10; in the case of *B. dysenteriae* Shiga or Flexner-Hiss, 1 in 6. Agglutination appearing within three minutes determines a positive finding, after three and within four minutes a partially positive finding. Four minutes is the full time limit to be given to the test.

As the agglutinin content of sera developed during bacillary dysentery infection is small in comparison with that in enterica and melitensis infections, a lesser dilution than the 1 in 10 was found necessary to detect the specific agglutinin in many of these cases. Tests were made in which the dilution was 1 in 10 and the time extended to five minutes, but in bacteriologically proven cases most of which were due to *B. dysenteriae* Shiga, seven per cent gave no agglutination throughout their illness when the cases were mild and were not treated at or early after onset by frequent salines, and fifteen per cent gave no agglutination when they were mild and were so treated. Frequent and comparative tests of varied dilutions showed that the 1 in 6 dilution of serum, and three or four minutes time limit given, as in testing agglutination of the other emulsions of the series in a 1 in 10 dilution, considerably increased the positive findings and gave more reliable results in bacillary dysentery cases.

During the carrying out of many comparative examinations by the established high titre methods at the temperature of the laboratory or at 37° C. or 55° C. and by the slide method, it was found that when a specific agglutinin action was determined by a high titre method a positive result was also detected by the slide method. Moreover, bacteriologically proven cases, especially those of bacillary dysentery when examined early, have shown a higher percentage of positive findings by the slide method; and there have been no inhibitory zones appearing with the dense emulsions employed.

Many strains of each group of micro-organisms that are being considered in this paper have been comparatively studied. The qualities sought in selecting a strain for the test are that it should not react to normal sera; secondly, that it should be as sensitive as possible to the specific agglutinins present in the sera of infected or inoculated persons; thirdly, that it should be as little as possible sensitive to the co- or hetero-agglutinins developed in the infections under study. Co-agglutinin and hetero-agglutinin action developed in sera during an infection cannot be avoided in all cases by the selection of any of the many strains I have worked with, but care in this selection and the shortening of time of observation has considerably reduced the number of sera that show these properties. The only micro-organism of those considered in this article which has developed hetero-agglutinin action in sera is the *M. melitensis*.

A point of great interest and value is that while employing the *dense* emulsions of practically medium-freed micro-organisms, I have been able to demonstrate by the method positive agglutination with sera in all dilutions tested when a zone of inhibition has appeared with a thin emulsion and the short or long methods employed. It may be that inhibition zones, which have been detected in the agglutination test, depend in some measure on the density of the emulsions employed; or, in other words, on the relation of the quantity of serum properties present to the quantity of micro-organisms on which these properties act.

In the Mediterranean Expeditionary Force one has constantly to be on the alert for the presence of any one or more of the several pathogenic micro-organisms. For example, the testing of serial emulsions has led to detecting a positive reaction to *V. cholera* in an alien from Serbia, not inoculated against cholera, who was admitted with a diagnosis of amoebic and flagellate dysentery, and to *M. melitensis* in one patient invalided from Mudros, suffering from amoebic liver abscess.

However, the agglutination test has not been diagnostic in every case, even when interval examinations have been made by either the slide or longer methods; but its value has been inestimable, and it has indicated in only the most exceptional cases misleading or constantly negative results. Considering that in the agglutination test there is but one constant factor, namely, the emulsion, and two inconstant factors—(1) The agglutinin response in the serum of the individual, and (2) the variation amongst

infecting strains of any one group—these rare difficulties in diagnosis by the agglutination test are comprehensible.

Professor Zammit and Dr. Rizzo Marich carried out some examinations on human blood sera and on goats' blood sera and milk for the agglutination of the *M. melitensis* by his own and by my methods, and obtained similar results. The blood sera of certain goats was in low dilutions positive for *V. cholerae* as well as for *M. melitensis* with which they were infected.

Observations have been made on more than 3,000 subjects. Bacteriological findings have given the necessary confirmation of the test in the majority of cases of infection. Some clinicians have shown its general utility in that they have been enabled thereby to test their patients' sera in their own side-rooms.

Preparation of Emulsions.—The morphology of the micro-organisms employed and their agglutinability should be watched and kept constant, and I have used for all subcultures a definite medium, which is ordinary nutrient agar with two per cent Witte's peptone titrated to plus ten acid to phenolphthalein. For the preparation of standard emulsions, subcultures of the stock growths preserved in an ice chest are grown at 37° C. for twenty-four hours (ninety-six hours for *M. melitensis* or *M. paramelitensis*) on similar agar. From the culture a platinum loopful is well emulsified in three cubic centimetres of Witte's peptone (two per cent) water, which is incubated for a few hours and then transferred to a Roux bottle containing the same agar medium for twenty-four hours (ninety-six hours for *M. melitensis* or *M. paramelitensis*). About ten cubic centimetres of 0·8 per cent sterile saline is then poured from a sterile pipette to wash off the culture. The growth plus saline from the Roux bottle is put into a tube and centrifuged in a high-power centrifuge till the micro-organisms are thrown down. The clear supernatant fluid is completely pipetted off and rejected. About ten cubic centimetres of formalized (2 per 1,000 commercial formaldehyde) 0·8 per cent sterile saline is added to the deposit by means of a sterile pipette to which is attached at the distal end a piece of rubber tubing and mouthpiece. By drawing the deposit up and blowing gently out many times an even emulsion is made. A loopful of the emulsion is stained and the morphology and purity of the micro-organisms examined. The emulsion is then placed in a very clean sterile test-tube and put into the ice chest. Sufficient time is given to allow any lumps to fall to the bottom of the tube, and the remainder is withdrawn and placed into a sterile flask with the quantity of formalized sterile saline that gives the required density. When an emulsion gives no growth on sowing, it is ready for its agglutinability to be tested. This test is carried out by means of the various high titre sera; the emulsions should show instantaneous agglutination in a dilution of 1/1,000 (titre of serum 1·8,000) in the case of the typhoid group, and in three minutes with emulsions of *M. melitensis* and the

dysentery bacilli. Both anti-sera Flexner and Hiss agglutinate the strain of Hiss employed. The other micro-organisms are only agglutinated by their respective anti-serum in the above test. When ready the emulsions are placed in rubber-corked phials two inches by $\frac{1}{4}$ inch for their preservation.

Standard Density.—The density was adopted as a standard after frequently trying various concentrations in saline of the micro-organisms with dilutions of their respective anti-sera in order to obtain that which best shows specific agglutinability within the time limit. Moreover, up to the present, with the emulsions in this density *I have not seen a zone of inhibition appearing when employing my method.* The varied sizes of the respective micro-organisms prevent standardization by counting unless a separate count is made for each. A suspension made by adding 6 cubic centimetres of a 1 per cent solution of $MgSO_4$ to a solution of 1 cubic centimetre of original lysol in 100 cubic centimetres of distilled water gives the same density when judged by translucency as does the standard emulsion of *B. typhosus*. The number of this bacilli per cubic centimetre is 27,000 millions. The other emulsions, save those of *M. melitensis* and *M. paramelitensis* which are prepared with a density three times that of the *B. typhosus* emulsion, are standardized by spreading them along with the *B. typhosus* emulsion in a broad stream on a clean slide, thus overcoming any difference in colour of certain micro-organisms when examined in tubes; judging with a lens the emulsion of unknown density is diluted so as to have the same opacity as the standardized typhoid emulsion.

In the cases of *M. melitensis* and *M. paramelitensis* the emulsions are standardized by diluting them until a loopful from a mixture of one drop of emulsion and two drops of normal saline corresponds in density to a loopful of the standard *B. typhosus* emulsion.

Technique.—One half of a cubic centimetre of blood is taken in a Wright's capillary tube and allowed to remain until the serum has separated from the clot. For the drops an ordinary Pasteur glass pipette has been found satisfactory. It is gauged to yield drops equal to one thirty-sixth of a cubic centimetre, i.e., half a minim when held perpendicular to the slide. The end of the pipette is drawn out so that the diameter of the terminal, $\frac{1}{4}$ to $\frac{3}{4}$ inch, is the same, so as to prevent the liquid running back the pipette before dropping. Graduated pipettes may be used. A rubber teat is attached to the other end of the pipette. In hospital routine work, I prepare three sedimentation tubes. Into the first is placed fifteen drops, into the second eight drops, and into the third and further tubes five drops of 0.8 per cent sterile formalized (2 per 1,000 commercial formaldehyde) saline. Three drops of serum free from blood corpuscles are placed in No. 1 tube, making with the 15 drops of saline already in it a 1 in 6 dilution. The contents of No. 1 tube are drawn up and blown gently back so as to mix them thoroughly, then 12 drops of this 1 in 6 dilution are placed in No. 2 tube to make a

1 in 10 dilution, the process of mixing is repeated, then 5 drops of No 2 is placed in No. 3 tube to make a 1 in 20 dilution. A piece of clear glass 8 by 1½ inches, with spaces divided off by etched lines, gives sufficient space for the examination of several emulsions at the same time, and can be regularly wiped over with a cloth, and by flaming to dry between each examination. Microscopic slides can be used, but one has to employ extreme care when more than three emulsions are being tested thereon, in order to prevent the drops running together. From the first tube in which the dilution is 1 in 6, a drop is placed at the top of each of the first two spaces on the slide. From the tube No. 2 a drop is placed at the top of each of the five remaining spaces. To obtain drops of the same size, each falls slowly from the tip of the pipette held perpendicular to the slide and just above it. A handled thin platinum wire is used for transferring the emulsions on to the slide. The terminal of the wire is brought round in a circular loop two millimetres in diameter and continued for a short distance evenly underneath but away from the superimposed portion, so that the loop empties itself each time it is brought to touch the slide. The loop is flamed and, being thin, rapidly cools before use for an emulsion. Such a piece of platinum wire may be affixed to the cork in each phial of emulsion. Just under the drops is placed a loopful of the emulsion in the following order: *B. dysenteriae* Shiga, *B. dysenteriae* Hiss (the strain used for Flexner-Hiss group), *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *M. melitensis* and *V. cholerae*. Other emulsions or the micro-organisms isolated are used as occasion may demand. When ready, the slide is lifted and turned so that the drops flow at the same time into the emulsions and down to the bottom of the slide, and the time is noted. As explained above, during the testing of a serum the slide must be frequently and gently half turned so that the drops may flow up and down. Half-minute readings are now made. The temperature of the slide during the test is kept at that of the laboratory during the tropical summer months, but in the cooler season it is kept at about 25° C. by passing it twice or thrice over the flame of a small spirit lamp. The addition of the emulsion I have considered practically negligible as regards the notation of the dilutions, since the emulsions are dense and there is slight evaporation, which is constant in all dilutions.

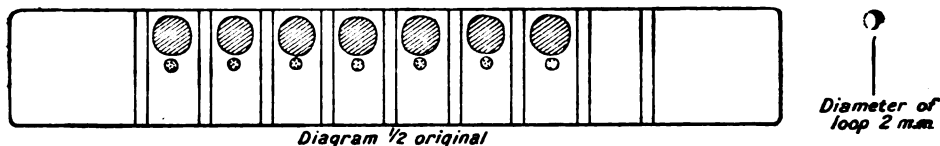
The systems of notation recording the results of time measurements are shown on next page.

If an emulsion of the *B. dysenteriae* groups in the 1 in 6 serum dilution or an emulsion of *B. typhosus*, *B. paratyphosus* A or B, *M. melitensis* or *V. cholerae* in the 1 in 10 dilution shows agglutination by the formation of definite *flocculi* within 3 minutes, the reaction is considered positive; if only after 3 minutes and within 4 minutes, the reaction is considered partially positive to the micro-organisms contained therein. Some workers may need a low-power hand lens in the examination of results, especially to detect the early stage of agglutination of

430 *Time-governed Slide Method for Agglutination Test*

M. melitensis. A black background screen is of advantage when the test is carried out in artificial light. Very rarely there develops in the drop of serum dilution and an emulsion, generally that of *B. dysenteriae* Hiss, a finely granular appearance, which may be likened, for descriptive purposes, to that seen in a precipitin reaction. Absence of flocculi excludes such an observation from being classified as a positive agglutination finding in the test.

Agglutination positive, shown by a formation of definite flocculi	or	Result may be recorded as—
+ Instantaneous	or	8 +
+ 30 seconds	7 +
+ 1 minute	6 +
+ 1½ minutes	5 +
+ 2 minutes	4 +
+ 2½ minutes	3 +
+ 3 minutes	2 +
± 3 to 4 minutes	± partial or ±
No agglutination in 4 minutes		
The dilution must of course also be noted.		



The test is extended only if indicated by the result of the initial examination. For example, (1) in the time measurement test when an emulsion is agglutinated immediately in the 1 in 6 or 1 in 10 serum dilution, an increased dilution that permits a measuring of the time necessary for agglutination to commence is sought, as thereby one may recognize in a similar dilution examined later any difference in the time necessary for the agglutination of the same emulsion to commence; or (2) when the end titre of the serum, as shown on the slide in three or four minutes, for the agglutinated emulsion is sought. Remaining drops of the 1 in 10 or the 1 in 20 dilution are ready for testing, and from the latter, if necessary, increased dilutions may be prepared.

When after the initial test drops of a series of dilutions have been prepared and employed in sequence on the slide for detecting the highest which agglutinates a loopful of an emulsion in three or four minutes, the result was reported by the usual system of titre notation with mention of the time required to show agglutination. Having had considerable experience of this and of the time measurement method detailed above, I find both are reliable, but the latter is more quickly done.

A platinum loopful of the emulsion for every 5 drops of serum dilution was put into each of a series of sedimentation tubes prepared by taking 5 drops of serum dilution from No. 3 tube into No. 4 tube containing 5

drops of saline, and so on from 4 to 5 and to the dilution desired, and the tubes after shaking them placed at 55° C. or at 37° C., or at the laboratory temperature, when a result from a longer method was required to compare it with any findings on the slide.

Modification of Technique for a Hot, Dry Climate.—In certain zones the temperature may be at or above 90° F., and the atmosphere be hot and dry, both day and night. Under such conditions, the evaporation is greater than in more temperate zones. I have, however, found most satisfactory results during two summers in the Mediterranean by giving a time limit of three minutes to the method and keeping in front of me a basin of water with bars across on which the slide can rest, and over which it can be manipulated. If one works slowly, it is more satisfactory to limit the number of emulsions to be tested at one time. Captain Garrow, R.A.M.C., one of the clinical staff to whom I demonstrated my method in his wards, subsequently devised a rocking chamber into which a slide is fitted when prepared for the test. His results have been published.¹

In my experience, I have not found it necessary to depart from the simplicity of technique above described and much is learnt by watching the test throughout. As the climatic conditions in tropical countries remain for practical purposes constant over an extended period interval agglutination results may be made and compared.

Technique for an Immediate Agglutination Test.—A little blood of the patient is carefully drawn into the pipette and four drops thereof (which correspond to two of serum) let fall into a sedimentation tube or watch-glass. When clotting has taken place, ten equal sized drops of formalized saline are added. A dilution of the serum 1 in 6 is thus made. Six drops of this dilution are placed in another tube or glass and four drops of formalized saline added—thus a dilution of the serum 1 in 10 is made. Each dilution is tested for agglutinin contents as above described.

Since writing the above I have employed this test during an outbreak of plague with most satisfactory results. A 1 in 6 dilution of serum was used in the initial test.

¹ JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, May, 1917.

Clinical and other Notes.

THE CARRYING OF THE WOUNDED IN TRENCHES.

BY LIEUTENANT B. GRAVES.

Royal Army Medical Corps.

THE obvious and practically only way of meeting the difficulty if a man is to be carried effectually along the compact space, and around the narrow angles of an average fire trench—where one meets right-angled turns with every few yards—is to render him himself compact. This I mention anticipating the comment that a wounded man should not be doubled up; if that is to be adhered to, in a very large number of cases he must needs remain where he is! I am convinced that in the majority of cases there is no harm whatever to a wounded man being compressed by flexion of his legs, provided he is automatically held in a position of reasonable comfort, and without the necessity of himself making conscious efforts to maintain that position, and that in those few cases to which it may be detrimental the circumstances must be accepted as unavoidable.

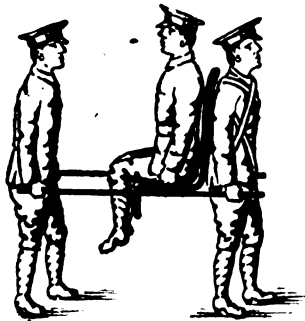
Almost as important is the question of the stretcher-bearer. It sounds so simple to talk of conveying a wounded man along the fire trench, and down the communication trench to the aid post "without delay"—let those that think so try it for themselves. From the point of view of pure physical exertion, the stretcher-bearer's is one of the most arduous of duties in an active period in the trenches. Struggling along under a very heavy load, trying to avoid different obstacles, frequently stumbling or slipping over the trench boards and uneven ground, and having at the same time to maintain his patient in a position of advantage—it does not require many such journeys to tire the strongest of men. Any small means contributing to lessen these difficulties are as important to the efficiency of the work of the stretcher-bearer as the many devices for the improvement of the pack have been to the comfort of the infantry man on the march.



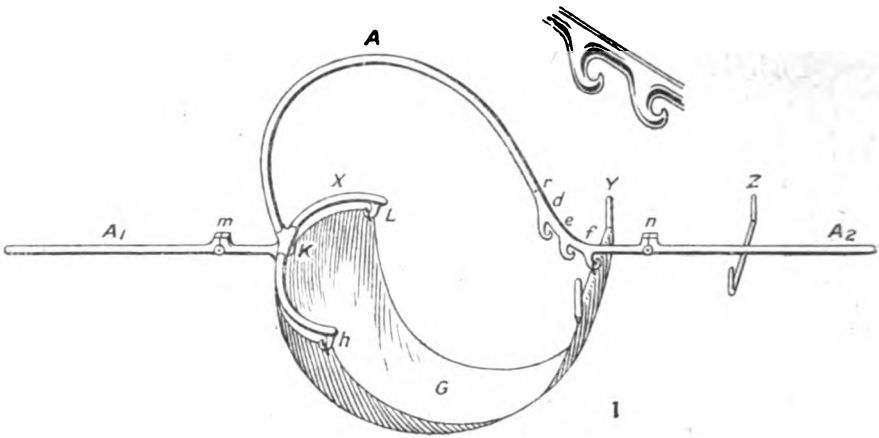
Bearing in mind the two main aspects—first the patients and then the stretcher-bearers—I have tried different means which have suggested themselves for meeting the difficulties. There are—though rarely—some parts in special trenches round which no conceivable form of stretcher or "carrier" could be manœuvred; such places are usually limited in extent, and for the short distance there may be no option but to drag the patient along the ground by his equipment. In such cases a rubber ground sheet is sometimes tried. As an improvement on this, a sheet of canvas of about the same size, provided with a rope ring at each of its corners, makes the task infinitely easier for the stretcher-bearer. These should not be difficult to make, say, to the number of one or two per company. One of my

stretcher-bearers made a good suggestion—that a sheet should be laid out on the stretcher before putting the patient on, so that on coming to corners which could not be negotiated with the stretcher the patient could with more ease be lifted off and carried round the narrow passage, to be again laid on the stretcher when the difficulty was past.

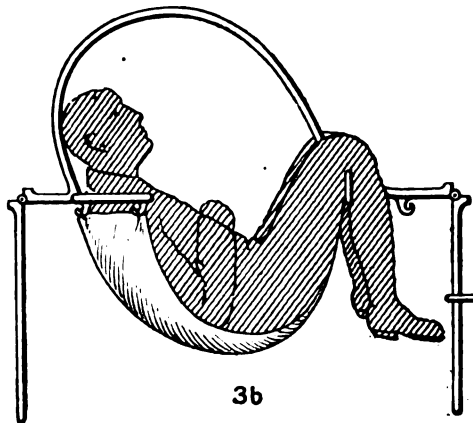
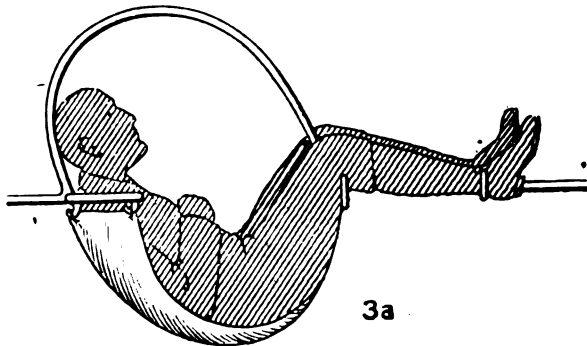
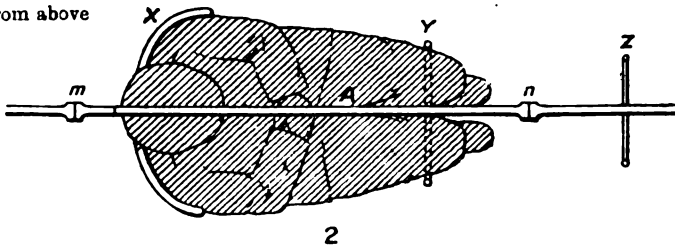
One of the most obvious ways of economizing space would be to carry the patient in a completely vertical position. It is not difficult to devise an arrangement borne on the shoulders of the two stretcher-bearers from which the patient is suspended at full vertical length, but any such arrangement is undesirable for the reason that, for his feet to clear the ground, his head must be at a high level involving undue exposure to fire. A similar objection applies to the method already tried of carrying the patient in a hammock slung from a pole on the shoulders of the bearers. There is, moreover, another objection to this means of carrying: when the weight to be borne is higher, and has its points of application directly on the shoulders of the bearers, it is necessary for the bearers to exercise considerably greater effort to recover balance from their frequent tendencies to stumble over the ends of trench boards, than when the total weight lies at a lower level. Further, to ease the weight on the shoulders from time to time, the bearer has to exercise an upward *pushing* effort with his arms involving a greater muscular effort than the upward *pull* of handles which are suspended low down in a sling from the shoulder. These disadvantages are to some extent overcome by a pattern of trench-stretcher recently adopted, but unfortunately the objections, in other directions, far more than outweigh any advantageous features that may be claimed for it; some of these will be evident from the accompanying sketch.



Firstly, to mount the patient on the stretcher requires the assistance of one if not two extra men, and the patient has to be subjected to some considerable manipulation before this is finished. The patient is in such a position that he has always himself to exert a certain amount of conscious effort to maintain it, and, in many cases, if a man is well enough to do this he may be well enough to crawl or walk. It is true that this design is of shorter length than the old pattern of stretcher, but it still possesses the objection of having two handles, widely separated, projecting at each end—always an objection when negotiating narrow corners. As the bearers walk along, practically all the weight is borne by the front bearer, and worse, owing to the fact that the upward continuation of the canvas which forms the seat is securely fixed by cross-straps to the front bearer,



View from above



Drop ends A1 and A2 when bearers are going round sharp corners, or when they wish to rest the weight on the ground.

it is impossible when they pause to temporarily rest the weight on the ground. For a similar reason, each bearer cannot alternately take the heavier end by an exchange of places. So great are these objections that I find my stretcher-bearers loth to use these, and they always prefer to leave them behind when going into the trenches!

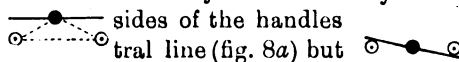
With a view to overcoming such objections, and also of gaining further advantages, I have suggested a design for a trench carrier, which seems to me satisfactory. In the accompanying illustrations, fig. 1 represents the appliance complete; fig. 4 its two component parts. *A* is a single steel tube (bicycle tubing), the straight extremities of which (*A1* and *A2*) are so jointed that they can drop through a quarter of a circle to the vertical position. A curved horizontal crossbar, *X*, is brazed to this tube at the point *C*; this is provided with three strong hooks, *H*, *K*, *L*, one at each extremity and one in the centre; there are three similar hooks, *d*, *e*, *f*, at a suitable distance apart on the other end of the curved portion of *A*. A short crossbar with upturned ends is fixed to the extremity *A2* at a suitable distance, to be explained below. A canvas sling, *G*, has, at one end, three rings (best fixed to a piece of thin rope sewn into the end of the canvas for strength) at distances corresponding to the hooks *H*, *K*, *L*. Into the other end of this canvas is sewn a length of steel tubing with upturned ends and having a single central ring, *p*, capable of being suspended to any one of the three hooks, *d*, *e*, *f*.

Figs. 5 (*a* and *b*) and 6 (*a* and *b*) illustrate the means of mounting the patient in this carrier *without the necessity of first lifting him from the ground*. The sling is spread at length under him by folding the canvas up against the bar *Y*, placing the whole under the knees, and then straightening out the canvas beneath him; it is somewhat similar to the device for placing a bed-sheet beneath a helpless patient. The steel tube frame is then lowered over, and the three rings on the hinder end of the canvas attached to the hooks *H*, *K*, *L*; the ring *p* is attached *between the patient's knees* to any one of the hooks, *d*, *e*, *f*—according to the length of the patient, and also whether it is desired to carry him as in fig. 3*a* or, when space is very confined, in the attitude of fig. 3*b*.

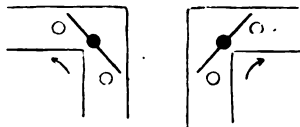
The bearer has a simple sling hanging from one shoulder down to the opposite side (fig. 9*a*, compare with 9*b*) to rather below the level of the hip.

The bearers proceed as in fig. 8*a*; on coming to a corner or when wishing to *pause for a rest*, they drop the extremities *A1* and *A2*, and hold by the short length which remains; should they pause these extremities *serve as legs* to rest the weight on the ground. At many of the less acute corners it is only necessary to lower one of these ends; or there may be circumstances when it is easier to get round by alternately lowering first one and then the other end. The objection may be raised that owing to the patient not being in a direct line with the bearers, but slightly to one side, the whole arrangement forms a sort of triangle with the patient and two bearers respectively disposed at the three angles, and consequent increase in width.

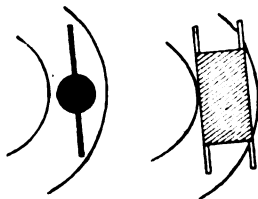
Not only is this readily obviated by disposing the bearers on opposite sides of the handles so that the patient comes in the central line (fig. 8*a*) but it is in reality an advantage. As an example, supposing the bearers are progressing as in fig. 8*a*, the front man to the right of the handle, the rear man to the left, and they come to a right-angled turn going say to the left, it is only necessary for the



front man to change sides (fig. 7a) to gain considerable advantage from this disposition when going round the corner, for the whole group then approximates to a curve having its convexity to the right. Correspondingly, to pass round a corner to the right it would be necessary for the rear man only of fig. 8a to change his side.



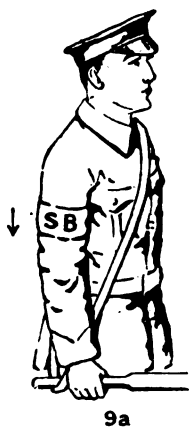
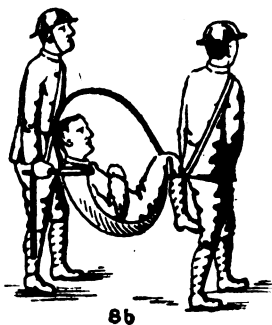
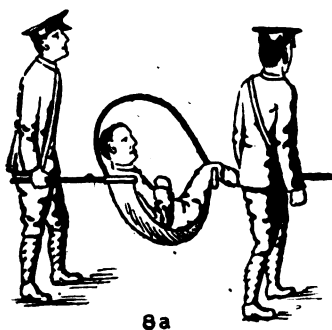
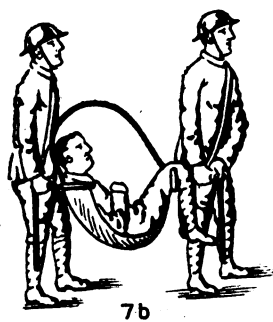
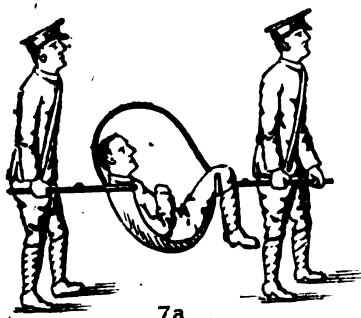
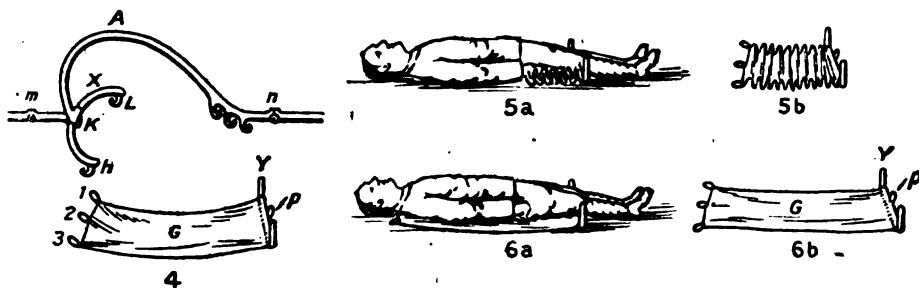
In regard to the question of width, this carrier is at no point wider than the patient—indeed, the patient's body forms the maximum width, a condition which cannot obtain in a stretcher, and this point of maximum width is approximately limited to the centre of the whole arrangement—a fact of considerable importance



Comparison with ordinary rectangular stretcher.

for negotiating curves. One attempt to carry a double-handled stretcher around corners and curves in trenches is sufficient to demonstrate the difficulties caused by making the stretcher in the form of a rectangle. (See diagram.)

It may be said that it is too heavy a load to be borne in one hand by the bearer; but the cross-sling relieves this, and it is not impossible to use both hands. Moreover there are salient points in this arrangement; firstly, the stretcher-bearer is free to use one hand for steadying himself against the side wall of the trench—this is of considerable importance over muddy or irregular ground, and saves much wasted effort on the part of the bearer. Secondly, the disposition of the carrier is not affected by suddenly removing one hand, as it may be when two laterally disposed handles are provided. Incidentally it is a matter of comfort to the patient to appreciate that the carrier does not twist laterally to unsafe angles with the risk of his falling out, as when lying on a plane surface held by two handles at each end. It has been suggested that the patient would swing laterally with each movement of the bearers; this is not so, for his centre of gravity is not far below the horizontal level of the handles, as a result of which there is little or no tendency for this to take place—experiments with an improvised wooden model have borne this out. Both for this reason and also owing to the design of the curve in the bar *X* there is little or no tendency for the patient to fall out laterally. Although he can be readily mounted or dismounted, once in he is secure; the canvas, conforming to the curve of the bar *X* for some distance down its length, embraces the patient who tends, by his own weight, to



Direct downward pull in lateral line with the centre of gravity of the body and bearing from the shoulder.

Compare: Pull downwards and forwards from the back of the neck by the sling of an ordinary stretcher, causing considerable fatigue and wasted effort.

automatically fall back into the hollow so formed. It might be said that unequal pressure on one side of the bar *Y* might tend to its tilting, and one leg or the other slipping off; but in the first place there is no reason to anticipate unequal pressure, and, as I have found in practice, the bar *Y* cannot rock in the vertical plane owing to the fact that each end is equally pulled upon by the edge of the canvas being kept *taut* with the patient's own body-weight.

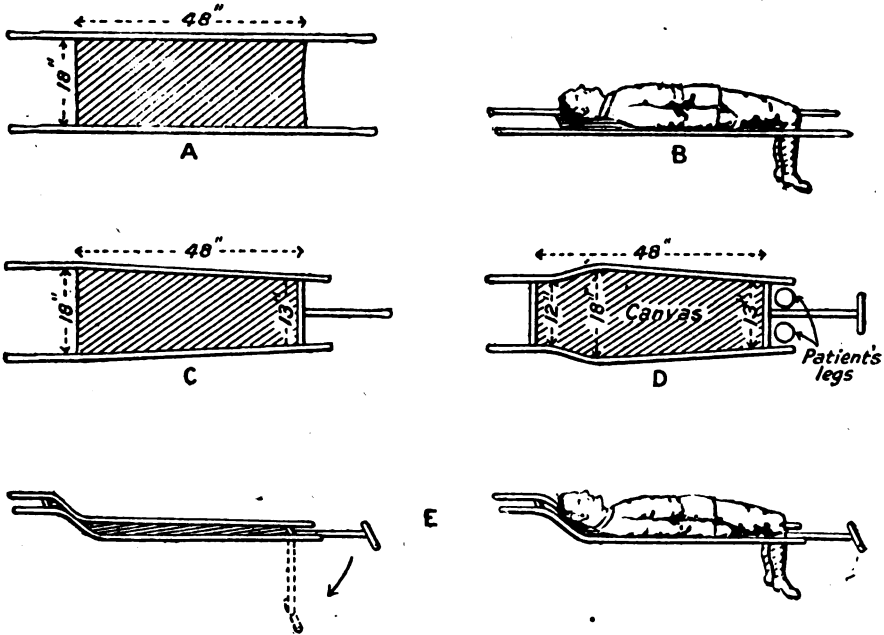
The purpose of the bar *Z* is obvious from figures 3*a* and 3*b*. I have not shown in the drawing a small addition which is desirable, namely, a small curved head-rest to each extremity of which a short length of webbing is attached to fasten round the head when a patient is unconscious. It will be found in practice that this need only be quite small. It is a good addition to have a small rope ring permanently fixed to each corner of the canvas—it facilitates mounting and dismounting the patient.

There are certain points from a structural point of view which it is necessary to mention. The first is the question of strength and where to apply it. At first sight one might think that the curved part of the bar *A* must be so strong as to be clumsy; this is not so. The line of the canvas completes an approximate circle, and when the handles are lifted by the bearers the only force operating on the curve *A* is one tending to compression throughout the line of this curve; any tendency to bending open of the curve is counteracted in the binding together of the ends of the arc by the tension of the canvas. On this account the bar *A* can be of relatively light tubing. The points actually needing strength are at the commencement of the straight ends, close to the points of attachment of the canvas. There is nothing against having a taut steel wire stretching on each side from the extremities of the bar *X* to a point, say *r* on the bar *A*; it would not interfere with the patient, but I do not consider it necessary. The approximate distance between the extremities of the arc *A* should be about two feet, and the length of the canvas must be such that the centre of gravity of the patient will fall below the horizontal level of the handles.

I think that this carrier altogether overcomes the disadvantages of the appliances mentioned above, in that it is light, of a medium width and length; the patient, though secure, is easily detached and is self-supported; the direction of the force is *directly downwards* and the weight is equally shared by the bearers who, besides having one hand free, can pause to rest the weight on "legs" at will. It should be simple to use by a stretcher-bearer once it is explained to him; it is after all nothing like so complicated as many of the contrivances we see nowadays in the trenches. A stretcher-bearer should surely be able to manipulate a carrier of this sort.

There remains only the question of the attitude of the patient from a medical aspect. One may occasionally come upon some unsuitable case, but not often. The compression of the abdomen by the thighs may be an advantage in "shock," comparable to the effect of bandaging the abdomen; and the elevation of the legs to bandaging of the limbs. In a case of fractured thigh it is not impossible, by putting a pad beneath the leg over the bar *Y*, to create extension by the patient's own body-weight. Flexion which is unavoidable in the trenches is by no means uncomfortable provided that the patient is *secure* and is so held without making any exertion of his own. I think the common idea that a wounded man must necessarily lie at full length to get the best advantage originates perhaps from the

Suggested modifications of an ordinary stretcher for cases in which it is essential that the patient should be flat.

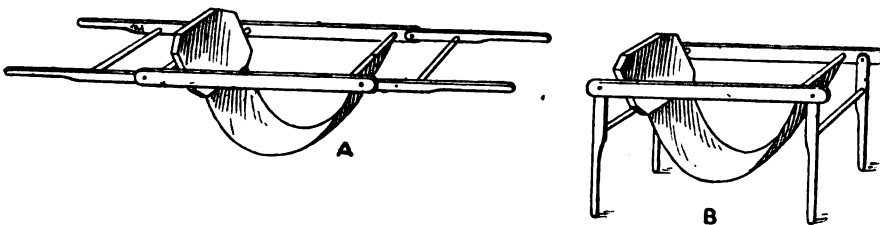


E, front extension hinged so that it may be dropped to vertical.

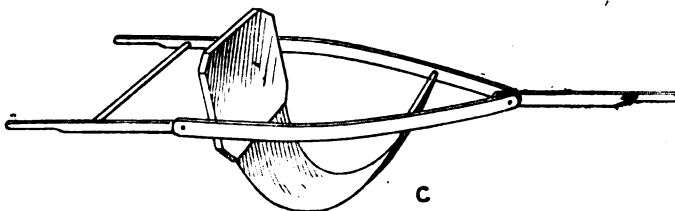
A, ordinary stretcher, shortened and reduced in width (dimensions of canvas = 48 inches by 18 inches), the patient's legs hanging down over end, B.

C, modification of A, making one end narrower (13 inches), and having a single central handle for front bearer.

D, improvement on C, frame for canvas made of light steel tubing, the head end also being reduced in width (12 inches). Lest there should be any tendency for the stretcher to rotate and turn over owing to lessening of the distance separating the two handles of the head end, these handles are so bent as to be slightly raised above the level as shown in side view, E.



To drop ends, stretcher-bearers spread knees to support handles, transfer grip of hands to ends of side-struts, and then remove support of knees from under handles, allowing the latter to drop down.

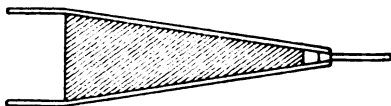


Improved pattern of above.

fact that we have not been accustomed to see wounded men carried in any other way. In using this carrier, I would have the ordinary stretcher kept by the bearers in a dug-out at the last point of constriction along the communication trench beyond which it is known there is freedom for the passage of these.

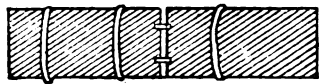
The carrier I have described would be taken about on the march by inverting it and laying it on the ordinary stretcher, with the curved part dropped down between the bars.

I may add that an improved pattern of the ordinary stretcher for use in communication trenches could be made by diminishing the width of one end, and substituting the two handles at that end by a single central one; with this it would be necessary



to tie a bandage or puttee around the patient's feet. This alteration would materially assist negotiation of curves.

There is yet another possible modification of the ordinary stretcher which might be very convenient in communication trenches with sharp turns, though it is not sufficiently modified to be of use in the average fire trench (see Diagram and Notes on p. 439). I also illustrate a suggestion for a device for getting patients in from No Man's Land without the necessity of the stretcher-bearers standing upright, viz., a jointed toboggan on three rollers drawn by a short length of rope.



Simple toboggan, in two parts, jointed together, the whole on three rollers, made in plain wood. For getting patient in from No Man's Land, stretcher-bearers crawling.

The accompanying illustrations (A, B and C on p. 439) show another model I have made and used (thanks to the assistance of a Royal Engineer officer) somewhat in imitation of the steel tube carrier, but it is not a good substitute, though being made of wood, it is not difficult to build. Though short it has wide extremities liable to catch on sharp corners; the whole thing is necessarily rather wider than the maximum width of the patient; and mounting a patient is not a simple matter as is the case with the other pattern. This design, however, as a compromise has its uses, and I intend trying one with a slight improvement, namely, to cut down the width of the front end as suggested above for an ordinary stretcher, and substitute a single hinged central handle projecting in front.

I may say that an arrangement on wheels would appear to me altogether impracticable for use over trench boards, as ordinarily seen.

In conclusion, if this steel carrier does possess certain disadvantages for some few selected cases or if a few corners can be found round which it could not

be carried, I would add that whilst no one device suggested by experiment can be capable of meeting every contingency, neither is any one likely to be destitute of value if it sufficiently reconciles a large number of obvious difficulties; this pattern seems to cover these more than any other I have tried.

AN INVESTIGATION INTO THE RESULTS FROM TREATMENT OF BACILLARY DYSENTERIES BY SERUM AND BY SALINES RESPECTIVELY.

By GERTRUDE MARGARET DOBRASHIAN, M.B., B.S.LOND.

Late Medical Officer and Registrar, Imtarfa Military Hospital, Malta.

DYSENTERY of a bacillary type has been extremely prevalent amongst our troops in the Salonica area, and has resulted in the invaliding to England of a number of men. The following investigation was therefore undertaken in order to ascertain, if possible, the relative efficiency of the two more important methods of treatment at present in use. From the large amount of material to which I had access it was finally decided to select only those cases which occurred during 1916, and in which the diagnosis of dysentery had been confirmed by bacteriological examination. Such a limitation has necessarily resulted in the inclusion of an unduly large proportion of exceptionally severe and complicated types of the disease, since a laboratory examination for all was an impossibility and was naturally reserved for the more acute cases or for those presenting special features. It was found that in 535 cases a dysentery bacillus had been isolated. These have been divided into two groups which are dealt with separately, viz., cases due to an infection by the bacillus of Shiga, and those due to an infection by either the bacillus of Flexner or the bacillus of Hiss (Y). Those showing mixed infections, e.g., by the bacillus of Shiga + *Bacillus typhosus*, have been excluded throughout.

The methods of treatment under consideration are the two now most commonly adopted, namely, treatment by anti-dysenteric serum either alone or in combination with salines, and treatment by salines only. As will be shown later, the dosage both of serum and of salines as administered to these cases was extremely varied.

SHIGA DYSENTERY.

The bacillus of Shiga was isolated in 395 cases, eleven of which terminated fatally. Eighteen cases which recovered and six fatal cases were instances of double infections and are therefore excluded from the following figures. A further eighteen are also excluded as they received neither serum nor salines during the course of their illness. It is, however, interesting to note that several of these latter who received practically no treatment became chronic carriers of the bacillus of Shiga.

Of the remaining 348, anti-dysenteric serum was given to 176, whilst 172 received salines only. As affording some guide as to the efficacy of treatment the cases have been classified according to their mode of progress towards convalescence, and in order to render the results more strictly comparable the day

of illness on which treatment was commenced has always been taken into consideration.

Class I.—Convalescence rapid. A total of 157 cases received treatment *on or before the fifth day of illness*. Of these, sixty-four per cent who were given serum made a rapid recovery, as compared with forty-eight per cent who received saline treatment only. Of cases coming under treatment *between the sixth and tenth days of illness* twenty-six per cent of those who received serum, even at this late stage, could still be shown to have made a rapid convalescence as compared with only fourteen per cent who received salines. Even *after the tenth day of illness* it is still possible to obtain five per cent of rapid recoveries, when serum is administered, though not a single case treated with salines at this stage could be placed in this class.

Class II.—Convalescence slow, but generally quite satisfactory. The slow rate of progress of cases in this group was often accounted for by an intercurrent attack of malaria. The majority were able to be transferred finally to a convalescent camp, though a small number of severe cases which were treated with serum were sent to England for the completion of their cure. The figures of cases in this class are shown in Tables I and II, and not much is gained by a further study of them.

Class III.—Convalescence Unsatisfactory. By this is meant a failure to respond to treatment or the development of some complication. This group is one of considerable interest. Of 157 patients treated *on or before the fifth day of illness*, in only nine per cent of those who received serum could convalescence be said to have been unsatisfactory, as compared with twenty-five per cent of those who received salines only. Of cases coming under treatment *between the sixth and the tenth day of illness* as many as twenty-seven per cent of those who received serum fall into this class, a fact which serves to emphasize the necessity for *early* treatment with serum. High as these figures are they are even higher for those who received saline treatment only, where it was found that in fifty-eight per cent convalescence was unsatisfactory. The majority of cases in this class had of necessity to be invalided to England, some showing every indication that their disease was passing on into one of chronic dysentery. The appended tables set forth the actual figures on which the above percentages are based.

TABLE I.—SHIGA DYSENTERY, TREATED WITH ANTI-DYSENTERIC SERUM.

Treatment begun on	Number of cases		Convalescence		
			Rapid	Slow	Unsatisfactory
1st day of disease	—	..	—
2nd „ „	..	9	8	1	—
3rd „ „	..	10	7	3	—
4th „ „	..	26	16	7	3
5th „ „	..	19	10	6	3
6th „ „	..	26	8	13	5
7th „ „	..	22	6	9	7
8th „ „	..	9	2	4	3
9th „ „	..	4	1	2	1
10th „ „	..	12	2	6	4
After 10th day	..	39	2	19	18

TABLE II.—SHIGA DYSENTERY, TREATED WITH SALINES ONLY.

Treatment begun on	Number of cases		Convalescence			
			Rapid	Slow	Unsatisfactory	
1st day of disease	..	2	2	..	..	—
2nd „ „	..	12	8	..	3	1
3rd „ „	..	30	14	..	10	6
4th „ „	..	29	13	..	6	10
5th „ „	..	20	8	..	6	6
6th „ „	..	16	5	..	3	8
7th „ „	..	20	3	..	7	10
8th „ „	..	9	—	..	4	5
9th „ „	..	6	—	..	4	2
10th „ „	..	5	—	..	2	3
After 10th day	..	23	—	..	6	17

It should be noted that not a single case with an unsatisfactory convalescence occurred amongst those treated with serum on or before the third day of illness, though such was not the case with those who received salines only. Moreover, after the seventh day of illness no single case treated with salines made a rapid recovery, whereas, even at this late stage, a small number who received serum thereafter made rapid progress.

Relapses.—It was noticed that there were several instances where patients, who appeared to have responded satisfactorily to treatment, suddenly developed a return of acute dysenteric symptoms whilst still in hospital. These have been termed relapses. All occurred within forty-five days of the original attack, and when finally invalided home several showed evidence of the condition becoming one of chronic dysentery. Of sixty-four patients who received serum *on or before the fifth day of illness* three per cent relapsed, whilst of ninety-three saline-treated cases, fifteen per cent relapsed. In those coming under treatment from *the sixth to the tenth day of illness* relapses occurred in 4 per cent who received serum, and in 19·6 per cent treated with salines only. Whilst of cases not treated until *after the tenth day* relapses occurred in five per cent of those who received serum and in 21·7 per cent of those who received salines only.

TABLE III.—SHOWING PERCENTAGE OF SERUM-TREATED AND SALINE-TREATED CASES WHICH BECAME CARRIERS.

Treatment commenced			Carriers	
			Serum	Salines
On or before 5th day of illness	..	..	1·5 per cent.	10·7 per cent.
On or before 10th day of illness	..	..	2·7 „	7·0 „
After 10th day of illness	..	..	10·0 „	21·7 „

Carriers.—Any case in which it has been possible to isolate dysenteric organisms eight weeks or more after the onset of illness has been classed as a carrier. Only a small number of examinations were made at this late stage of the disease, so that these figures are necessarily incomplete. As already mentioned several instances of carriers occurred amongst men whose original attack of dysentery had been so mild that a restricted diet and a single dose of an aperient relieved them of all symptoms for the time, but as these had received neither salines nor serum, they are not included in the following figures. Of cases treated *on or before the fifth day* of illness only one who received serum is known to have become a carrier as compared with ten who were treated with salines

only, a percentage of 1·5 and 10·7 respectively. The value of serum in the *prevention* of these carriers is best shown in the accompanying table (Table III), and again it will be seen that to obtain the best results serum should be administered early in the disease. Trial was made of serum for the *treatment* of these carrier-cases but without any benefit.

Arthritis.—When examining the records of several thousand cases of dysentery, arthritis as a complication was found to occur in only a very small percentage. The majority developing this complication were, however, bacteriologically examined and hence an unduly high percentage is shown in the present series of bacteriologically proven cases. It is interesting to note that arthritis was often found associated with conjunctivitis or with iritis. In two instances patients with arthritis were found to be Shiga carriers. In 137 cases treated with serum *on or before the tenth day of illness* no single instance of arthritis occurred, whilst of thirty-nine cases which did not receive serum until after the tenth day arthritis occurred in one. Trial was made of serum for the *treatment* of this complication, but without any apparent benefit, and nearly all cases had finally to be invalided home.

Cardiac Complications.—These comprise chiefly cases of cardiac dilatation, though there are included also a few instances of persistent tachycardia where no record has been made as to the condition of the heart. Of 157 patients treated *on or before the fifth day of illness* cardiac complications occurred in six per cent of those who received serum, and in fourteen per cent of those who received salines only. For cases treated *after the tenth day* cardiac complications occurred in 15·4 per cent of those who received serum and in nine per cent of those receiving salines. The smaller percentage amongst these saline-treated cases which came under treatment late in the disease can be readily accounted for by the milder, less toxic type of disease which these patients exhibited.

TABLE IV.—SHIGA DYSENTERY. COMPLICATIONS AND SEQUELÆ IN SERUM AND IN SALINE-TREATED CASES.

Day of illness on which treatment commenced	Number of cases		Relapsed		Carriers		Arthritis		Cardiac complications	
	Serum	Salines	Serum	Salines	Serum	Salines	Serum	Salines	Serum	Salines
On or before 5th day	64	93	Percent 3	Percent 15	Percent 1·5	Percent 10·7	—	Percent 5·3	Percent 6	Percent 14
On or before 10th day	73	56	4	19·6	2·7	7	—	5·3	16·4	16
After 10th day..	39	23	5	21·7	10	21	5	4·3	15·4	9

Deaths.—There were five fatal cases and death was found on post-mortem examinations to be due to *B. dysenteriae* Shiga infection, and only one received serum before the tenth day of illness. This was an acute case admitted very toxic on the second day and treated at first with salines only. On the seventh day he became slightly jaundiced. On the seventh, eighth and ninth days serum in twenty cubic centimetres doses was administered subcutaneously. On the tenth day the stools are noted as much improved in character, but on the thirteenth day the patient suddenly collapsed and died. Three fatal cases were instances of dysentery complicated by the occurrence of malarial attacks during

the acute stage. No serum was given until the fourteenth, thirty-fourth and fifty-sixth days of illness respectively, and death occurred on the fifteenth, forty-second, and sixty-eighth days respectively. The remaining case was treated with salines from the fifth to the eleventh day, when twenty cubic centimetres of serum were administered. Diarrhoea still continued. On the thirty-fifth day he began to pass much bright blood, which continued for six days. Emaciation became extreme. On the one hundred and fourteenth day symptoms pointing to perforation set in and death occurred four days later.

FLEXNER-HISS DYSENTERY.

Cases of dysentery due to an infection by the bacillus of Flexner or by the "Y" bacillus have been grouped together, there being only 140, and clinically they much resembled each other. With but three exceptions the cases were of a milder type than those due to an infection by the bacillus of Shiga, and there were no deaths. Ten patients had double infections, and are therefore excluded from the following figures, together with a further twenty-eight who received neither serum nor salines during the course of their illness.

Serum-treated Cases.—Only thirty-five cases of Flexner-Hiss dysentery received any serum treatment. Of eighteen treated *before the fifth day of illness* convalescence was rapid and satisfactory in fourteen. One became chronic and developed persistent tachycardia, two others developed cardiac dilatation and one relapsed and was known to be a carrier of the Flexner bacillus fourteen weeks after the onset of illness. Of seventeen cases treated *after the fifth day* convalescence was rapid and satisfactory in ten. Four showed signs of the condition becoming chronic and were invalided home, whilst three others developed cardiac dilatation. A point worth noting is the fact that cases with an infection by the "Y" bacillus did not respond to serum treatment as satisfactorily as did cases with an infection by the Flexner bacillus.

Saline-treated Cases.—Sixty-seven patients were treated with salines only. Of these forty-four received treatment *on or before the fifth day of illness*, and twenty-three made a rapid recovery. Convalescence was unsatisfactory in nine cases, four of whom had had relapses. Cardiac complications occurred in five, and one case was known to have become a carrier. Of twenty-three patients treated *after the fifth day of illness* only six made a rapid recovery. Convalescence was unsatisfactory in eight, all of whom had finally to be invalided home. There were five cases which relapsed, five which developed cardiac complications, and three who were known to have become carriers.

In this group of Flexner-Hiss infections there was only one case of arthritis, and it is doubtful whether even this one could be classed as a true dysenteric arthritis, as the patient had for many years been subject to attacks of "rheumatism" associated with swelling of various joints. Whether arthritis ever occurs as a complication in dysentery of this group is a point requiring more accurate observation. There was, indeed, one other case of arthritis not included in the present series as no pathogenic micro-organisms could be isolated from the stools. His blood-serum, however, agglutinated the bacillus of Flexner sufficiently strongly to indicate that his dysentery had been due to infection by that organism. Neither of the above recorded cases of arthritis was associated with iritis or with conjunctivitis.

A summary of the results following treatment of Flexner-Hiss dysenteries is appended in Table V.

TABLE V.—COMPARING RESULTS FROM TREATMENT BY SERUM AND BY SALINES RESPECTIVELY IN FLEXNER-HISS INFECTIONS.

Method of treatment	Convalescence unsatisfactory	Carriers	Relapsed	Cardiac complications
<i>Serum</i> before 10th day ..	7 per cent ..	3 per cent ..	3 per cent ..	17 per cent
<i>Salines</i> before 10th day ..	22 „ ..	6 „ ..	14 „ ..	15 „

Methods of treatment as exemplified in the present series of cases. In the treatment of these bacteriologically diagnosed dysenteries there is exhibited a marked degree of variation as to dosage and the frequency of administration of the doses both of serum and of salines.

Anti-dysenteric Serum.—The serum used was in the majority of cases a polyvalent one. A few cases of Shiga dysentery in garrison troops were treated by Dr. B. M. Cunningham with Shiga anti-dysenteric serum (Pasteur Institute) supplied through the kindness of Major W. Broughton-Alcock. Serum was at times given alone following a single dose of some aperient medicine, at other times in combination with salines administered more or less frequently. The smallest single dose was ten cubic centimetres—this patient (Flexner dysentery) received such a dose on the sixth and eighth days of his illness with but little benefit, followed by twenty cubic centimetres on the tenth day. Convalescence was slow, the man not being fit for convalescent camp until the end of the fourteenth week.

Another case received ten cubic centimetres on the tenth, eleventh and thirteenth days of illness; he developed severe serum sickness on the twenty-third day, followed by persistent tachycardia, but was transferred to the "Heart Clinic" of a convalescent camp at the end of fourteen weeks.

Several severe toxic cases received 100 cubic centimetres or more at one dose; one such case coming under treatment on the fourth day of illness was given 115 cubic centimetres of serum on the fifth day and 120 cubic centimetres on the sixth day. Convalescence was rapid, and the patient was transferred to camp at the end of eight weeks. The largest total amount of serum given to any one patient was 420 cubic centimetres. Treatment was not commenced until the seventh day; from then onwards to the twentieth this man received doses varying from 100 cubic centimetres to 20 cubic centimetres. He was transferred to camp at the end of eleven weeks. Another patient received between the sixth and thirteenth days a total of 340 cubic centimetres of serum together with intravenous salines and drachm doses of sodium sulphate by the mouth. He went to camp at the end of eight weeks. It is interesting to note that in both these cases serum sickness was mild.

From a study of the case-sheets of patients treated by serum it would appear that the best results are obtained where serum has been given in fairly large doses (forty to sixty cubic centimetres of polyvalent serum) and on consecutive days, salines being administered simultaneously by the mouth. The following examples serve to illustrate this point and its converse.

Salines.—The statement "case treated with salines only" in practice meant varying dosage and intervals, and largely depended on the severity of the case. Some medical officers would prescribe sodium (or magnesium) sulphate in drachm

or half drachm doses every hour for six, twelve or even twenty-four doses; others every two hours for twenty-four hours followed by less frequent doses. Other cases would receive these doses only every four hours and occasionally a mild case would be ordered salines only three times daily.

TABLE VI.—SERUM TREATMENT, WITH FAIRLY LARGE DOSES GIVEN ON CONSECUTIVE DAYS.

Case No.	Treatment commenced	Days on which serum given	Daily dose of serum	Result
			Centimetres	
7	6th day of illness	6th, 7th and 8th	60, 40, 40 ..	Convalescence rapid and uneventful
11	4th " "	4th, 5th, 6th and 7th	60, 40, 40, 40	" "
25	7th " "	7th and 8th ..	60, 60 ..	" "
104	2nd " "	2nd and 3rd ..	60, 60 ..	" "
112	4th " "	5th, 6th and 7th	60, 60, 60 ..	" "

TABLE VII.—SERUM TREATMENT, SHOWING EITHER TOO SMALL DOSAGE OR INTERVALS BETWEEN DOSES TOO LONG.

Case No.	Treatment commenced	Days on which serum given	Daily dose of serum	Result
			Centimetres	
9	5th day of illness	12th and 14th ..	40 and 20 ..	Slow progress. Invalided home
21	2nd " "	5th, 6th, 7th, 9th and 11th	20 each dose	Slow progress. Cardiac dilatation. Invalided home
57	7th " "	8th and 11th ..	60, 60 ..	Unsatisfactory result. Invalided home
431	2nd " "	3rd and 6th ..	50, 40 ..	Slow progress. Invalided home
86	4th " "	4th, 6th and 11th	20, 20, 40 ..	Unsatisfactory progress. Invalided home
301	3rd " "	5th, 6th and 11th	20 each dose	Became chronic. Invalided home

Summary.—It would be very difficult to obtain a parallel series of cases of equal severity and treated uniformly, on the one hand with serum combined with salines and on the other hand with salines only. Such an achievement could alone give strictly comparable results. Had it been possible to have included in this report every case of dysentery which passed through the hospital the results as obtained from *all* cases treated with serum would have still been by far and away the best, though at the same time the results from *all* cases treated with salines would have been better than in the present series of cases.

In spite of the severe type of case which was treated with serum the results have been shown to be vastly superior to those from cases which received salines only. All the figures, however, bring out the importance of early serum treatment. It should be noticed that no fatal case occurred amongst patients treated before the end of the first week. Even in Shiga dysentery eighty-eight per cent of cases treated from the second day and seventy per cent of those treated from the third day of illness made a rapid recovery, nor was there from amongst these cases a single one which had to be invalided home or which did not finally make a complete recovery. Even of those treated on or before the fifth day there were

only ninety per cent whose convalescence could in any way have been termed unsatisfactory.

Moreover, as a preventive of certain complications and sequelæ, serum holds a most important position. For example, it has been shown that not a single case of dysenteric arthritis occurred among patients who were treated on or before the fifth day of illness, and though data are necessarily incomplete, carrier cases would appear to be of far less frequent occurrence when serum has been used. Further, in spite of the toxic condition of so many of the patients when they first came under observation, only six per cent of those treated on or before the fifth day developed cardiac dilatation or persistent tachycardia. Not only was convalescence rapid when serum was given early, and repeated in adequate doses, but relapses were very rare, so that a more rapid evacuation of patients to convalescent camp was possible than in the case of those treated with salines only. The average duration of hospital treatment for the two classes of cases was found to be 8·6 and 9·6 weeks respectively.

It is therefore urged that there should be :—

(1) A more extensive use of anti-dysenteric serum which should be given at the earliest opportunity.

(2) That doses should be adequate, by that I mean at least 40 cubic centimetres of polyvalent serum, for a case of moderate severity.

(3) That two, three, or even four such doses should be given on consecutive days.

(4) That at the same time salines by the mouth should be administered frequently, drachm or half drachm doses every hour or every two hours until the stools become fæcal, and thereafter in gradually diminishing doses.

In conclusion I desire to tender my thanks to Lieutenant-Colonel G. B. Price, Officer Commanding Imtarfa Military Hospital, and to Major W. Broughton-Alcock, officer in charge of laboratory, Imtarfa Military Hospital, for facilities given to me for my work and for much encouragement and kindly advice.

Reviews.

THE CAUSATION OF SEX IN MAN. By E. Rumley Dawson, L.R.C.P.Lond., M.R.C.S. London: H. K. Lewis and Co., Ltd. Second Edition. 1917. Pp. 226. Price 7s. 6d. net.

In the second edition of his interesting monograph, Mr. Rumley Dawson has strengthened the evidence in support of his contention that the sex of an unborn child may not only be foretold but also even predetermined. The author's aim is to prove that unilateral ovulation occurs bimensually, and that the ovum proceeding from the right ovary is invariably endowed with male potentiality. Evidence in support of this theory is quoted from the results of operations and post-mortem examinations on cases of extra-uterine pregnancies and also by examples showing the interdependence of the succession of sexes and month of birth in large families. A careful scrutiny of the facts brought forward by the author leads one to the conclusion that his theory is worthy of serious consideration by all medical men,

and by gynæcologists in particular. The book is written in an interesting style, and is easily comprehensible by intelligent readers outside the medical profession.

W. J. D.

THE PRACTITIONER'S POCKET PHARMACOLOGY AND FORMULARY. By L. Freyberger, J.P., M.D. London: William Heinemann. 1917. Pp. 545. Price 12s. 6d. net.

The object of this volume is to provide medical men with a handy epitome of the essential facts concerning the drugs in the British and United States pharmacopœias, and in addition to supply information on the more useful non-official drugs. There is no doubt that success has been obtained, for the book describes briefly the characters, mode of dispensing, pharmacology, therapeutics, dosage, and toxicology of practically every drug on which information is likely to be sought by practitioners. Particulars are also given of many trade preparations which, through advertisement, have become familiar by name at least to the medical profession; the dilutions of drugs required to prepare lotions, etc., are stated, and formulæ have been included to illustrate the methods of prescribing many of the drugs; these features should prove useful for reference purposes. A more critical selection, however, of the diseases mentioned under the heading "Indications" would, in our opinion, have improved the book, thus those referred to as amenable to treatment by conium furnish one case in point.

The volume is arranged on strictly alphabetical lines, and concludes advantageously with an index of the drugs grouped according to their therapeutic uses. The book, which is published in a form convenient for the pocket, can be warmly recommended to practitioners as a concise and handy dictionary of information on modern remedies.

W. J. D.

THE AFTER-EFFECTS OF WOUNDS OF THE BONES AND JOINTS. By Aug. Broca, Professor of Topographical Anatomy to the Faculty of Paris. Edited by R. C. Elmslie, M.S., F.R.C.S., Major, R.A.M.C. (T.), Orthopædic Surgeon to St. Bartholomew's Hospital. [Military Medical Manuals, University of London Press.]

A work upon this subject is greatly wanted. The military hospitals of all countries are full of men with persistent sinuses and stiff joints, and these conditions, although, of course, quite well known, had become comparatively so rare before the War owing to a prolonged period of antiseptic surgery that they possess for many surgeons features of novelty. The result, in Professor Broca's words, is that "the older surgeons have renewed their experience of, the younger have seen for the first time, these interminable effects of a diffuse traumatic osteomyelitis." The picture that he draws in the opening paragraphs of Chapter III of the conditions prevailing in the hospitals in France with regard to the treatment of these chronic bone sinuses is a natural outcome of this comparative novelty of chronic septic osteomyelitis, and it doubtless applies to all the contending armies. Therefore we are prepared to welcome a book that aims at presenting a well-proportioned account of these refractory sequelæ and their treatment.

The only criticism that we are inclined to make upon the work as a whole is that the author tends to look upon his subject as an established and unavoidable condition, the main interest of which is the treatment. It would seem better to take the view that the primary point of interest in this lamentably frequent condition is whether or not it is possible to prevent its occurrence by treatment applied in the earliest stages of the case. Upon this aspect of the case Professor Broca does not touch; a matter for regret, since there must be a strong feeling in the minds of some of those who have been able to follow gunshot fractures throughout their course that it ought to be possible by appropriate measures to prevent much, if

not all, of this subsequent disability. The primary factor is, of course, sepsis, and there is no doubt that the injurious influence that this has exerted upon fractures in the past is greatly diminished owing to the improved methods of early wound treatment now in vogue. The only other really important factor is the presence in the callus of sequestra due to the death of more or less adherent splinters. It would have been interesting to have Professor Broca's views upon the possibility of eliminating these adverse factors, for without doubt this lies at the root of the whole matter. If by early and radical treatment a fracture can be put into such a condition that sequestra will not form, the occurrence of chronic septic osteomyelitis would be practically at an end, and gunshot wounds of bones—and to a great extent of joints also—would lose nearly all their gravity both from the surgical and the economic point of view. In this connexion it is interesting to note the views of another distinguished French surgeon, Professor Leriche, who deals very lucidly and forcibly with this subject in his two volumes upon *Fractures in the same series*.¹ The question is one that might profitably form the subject of a special research. In the hands of an able surgeon provided with facilities for early operation and prolonged observation, it should yield one of the most valuable pieces of work in war surgery. Running through the whole of chronic septic osteomyelitis is found the condition which was always a bugbear to operating surgeons before the War, but which has now assumed very serious proportions indeed, viz., the septic cavity in the bone. Any method that offers the surgeon a reasonable prospect of avoiding the occurrence of such a cavity would be a very valuable advance in treatment.

Professor Broca's book hardly calls for detailed criticism. As Major Elmslie says in his Introduction to the English Edition, "the methods of treatment advised are such as cannot be disputed by any surgeon who is experienced in the treatment of diseases of the bones." For us the chief merit of the book is the emphasis it lays upon the necessity for dealing with these cases as if they were really serious and not mere trivial matters to be left to the unskilled or the untrained. Any surgeon who reads it will never be likely to regard the sequelæ of injuries to bones and joints too lightly: they will appear to him in their true light as a group of the most crippling and baffling cases with which he can be called upon to deal.

The sections upon treatment are broad-minded and sound, and the insistence that treatment should be based upon accurate knowledge of the actual conditions present and should be rigidly purposeful is very much to the point. The description of the steps of the typical operation upon a bone sinus is most excellent: the greatest stress is laid upon the radical treatment of sinuses leading down to cavities in bone, and this is one of the most valuable parts of the book; it should finally dispose of the view that these sinuses can be adequately dealt with by means of a sharp spoon. The truth is that a radical and often an extensive and severe operation is required, and this must be based upon accurate localization, and extremely searching and painstaking in its performance. It is to be noted as a point of interest that the author never employs a tourniquet in these operations. His reasons for this are not clearly stated, which is to be regretted, since his practice is opposed to that of many surgeons.

Another point of general interest and importance that is strongly emphasized in this book is that stiff joints should be kept at rest until all articular osteitis has subsided. The same point has been strongly urged by Professor Leriche in his book on *Fractures involving Joints*, and a disregard of this advice has led to many disastrous results in the earlier days of the War at the hands of those who, judging by the conditions in the pre-war period, saw in an ankylosed joint an

¹ "The Treatment of Fractures." By R. Leriche, Assistant Professor in the Faculty of Lyons. (Military Medical Manuals.)

articulation that required for its satisfactory treatment frequent forcible movement. That the exact reverse is the truth is clearly pointed out in the book before us. A further point, which is in striking contrast to the views of the majority of surgeons in the pre-war period is the value of gradual mobilization of a stiff joint as opposed to sudden and complete restoration of its movements by force. On this point Professor Broca gives valuable advice, drawn from his extensive experience. The ground is well covered, and most of the known methods are dealt with.

The subject of the influence of malunited fractures upon the action of neighbouring joints receives separate consideration from the point of view of the normal and pathological mechanics of the bones and joints. This subject is very inadequately dealt with in ordinary works on surgery, and the reader will find in this part of the book much to interest and instruct him. From it he will learn the mechanical disabilities that may follow malunion of a fracture and the principles underlying their successful treatment, namely, the discovery of the actual mechanical cause and its correction if possible by osteotomy, instead of wasting time and effort upon massage and mechano-therapy which can be of no possible service.

The book concludes with some medico-legal considerations arising out of the cases under notice. These are, of course, primarily directed to the conditions in the French Army, but they have a distinct bearing upon those in our own country and well repay perusal.

It is an excellent book, by a well-known authority, full of sound teaching and well up to date. It is well translated and easy to read. F. F. B.

EMERGENCY SURGERY. By John W. Sluss. Fourth Edition. Illustrated. London: William Heinemann. 1917. Pp. xix and 848; $7\frac{1}{4} \times 5$.

An excellent and practical book which should be in the library of every student and practitioner; it is full of interest and information. Only one objection can be urged against it, and that is that there are more printing errors than should be found in a fourth edition, but this does not detract from the marked merit of the work.

HEATH'S MINOR SURGERY AND BANDAGING. London: J. and A. Churchill. 1917. Pp. x and 476; $7\frac{1}{4} \times 4\frac{1}{2}$.

Heath's "Minor Surgery and Bandaging," edited by Mr. Morrison Davies, has now reached its sixteenth edition (after being first published in 1861). The book is written particularly for the use of dressers, house surgeons and junior practitioners, and it may be confidently recommended to their notice. This last edition contains a new chapter on gunshot wounds, but since modern war surgery moves so rapidly, this will probably soon need revision.

REVIEW OF TROPICAL DISEASES: A MANUAL OF THE DISEASES OF WARM CLIMATES. By Sir Patrick Manson, G.C.M.G., M.D., LL.D., etc. London: Cassell and Co., Ltd. 1917. Pp. xxii + 968.

First published in 1898, Sir Patrick Manson's Manual of Tropical Diseases has exhausted five distinct editions besides several reprints—evidence indeed of its popularity and of its having successfully fulfilled its original purpose, viz., the provision of a handy sized volume for practitioners in the Tropics.

A sixth edition is now published bringing the subject matter fully into line with present-day knowledge.

The manual as the outcome of a long lifetime's experience in the clinical, laboratory and teaching aspects of tropical diseases, is full of useful information and stimulating indications for future research.

Only a very carping criticism could direct attention to minor errors and omissions, more especially as the work deals with a varied series of diseases which of late years have received much attention from investigators in widely separated parts of the world. Under such conditions it must be an extremely difficult matter for an author to decide upon what to eliminate and what to retain. The author himself has already pointed out two such omissions in his letter of December 11, viz., the omission of Dr. Water's work on epidemic bronchial spirochaetosis in India, and the omission of Drs. Dutton and Todd's work in connexion with the development of the spirochaete of tick fever in the *Ornithodoros moubata*.

It is significant that the author concludes his chapter upon the malarial parasite with a suggestion that, complex as it is already, the story of the parasite may not yet be complete; he directs attention to the possibility of yet another intra-corporeal phase, perhaps some encysted form capable of lying latent and under certain conditions waking to activity and so bringing about relapses; also to the possibility of some other extra-corporeal form by which infection may be conveyed from the mosquito to its larvæ, or some phase which may carry on the species through other warm-blooded hosts than man.

The original classification of malignant parasites is still adhered to, viz. :—

- (1) Subtertian.
- (2) Quotidian.
 - (a) Pigmented.
 - (b) Not pigmented.

Basing his opinion upon clinical manifestations, the author is inclined to believe that even this classification may not complete the list.

He does not touch upon the results obtained from artificial cultures by observers later than Bass except to mention that Bass's observations have been confirmed by others; the important observation of the clumping tendencies displayed by malignant parasites in artificial cultures as these parasites near maturity is not referred to. This omission is all the more unfortunate as the tendency to clumping would appear to afford a very reasonable explanation of the almost complete absence of parasites from the peripheral circulation for some hours previous to the rigor or *accès* of temperature in many cases of malignant infections.

The exact rôle of quinine in the treatment of malaria, he admits, is as yet very imperfectly understood. Can it for instance accomplish anything more than the temporary arrest of schizogony? Some authors would have us believe that something like a sterilization magna is possible and apparently with that end in view advise quinine to be given much more freely than Sir Patrick recommends in his routine treatment.

In three sentences the author points out that quinine is not wholly effective against the parasites, that quinine is a double-edged tool capable of doing harm as well as good and that other factors, vital vigour and physiological rest, play important parts in warding off relapses.

Quinine favours latency, nowhere does he suggest it being a permanent cure. Until we know what and where the latent phase is we cannot learn directly the effect of quinine upon it, but, on the other hand, experience affords abundant evidence that cases of malaria relapse or do not relapse after intensive quinine treatments, after milder quinine treatments, after tonic treatments and after no treatment at all. At the present time, the important point to determine is how much of the debility, especially cardiac debility, seen amongst malaria-stricken soldiers is due to malarial degeneration, how much to excessive physiological strain and how much to the effects of intensive quinine dosage. In other words, can intensive treatment bring about a greater evil than the condition it is given to relieve? This is a problem of immediate and national urgency and one deeply

regrets that the author with all the weight of his experience has not dealt with it at greater length. But from the tenor of his writings one, I think, could infer that he would not be in favour of intensive quinine courses.

Regarding the mode of administering quinine he gives precedence to the oral route, next in order to the intramuscular, thirdly to the rectal and lastly to the intravenous route, and apparently he would reserve the intravenous injection for special cases. This is a view that possibly many will question, judging from the trend of recent literature—Bacelli and Wright's methods for intravenous administration are both quoted but no remarks are made upon their relative values, a point of considerable importance to practitioners in the Tropics, whose conveniences for giving an intravenous injection are often far from being all that could be desired unless the technique is made as simple as possible. Bacelli's method, 10 cubic centimetres of a 10 per cent solution, or 5 cubic centimetres of a 20 per cent solution injected slowly, as recently recommended and reported upon in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, both fulfil the condition of simplicity, whereas Wright's method of giving the dose in 250 to 300 cubic centimetres is practically impossible without elaborate conveniences.

Blackwater fever, for so long regarded as a phenomenon of malarial fever, has in this edition, as in some previous editions, a chapter to itself, and the author suggests that it may possibly be due to an infection of the Babesia group and that quinine and malaria merely act as secondary agents—depressors of vitality—in precipitating an attack. He advises quinine to be given during an attack if the attack is associated with malaria parasites in the circulating blood.

Now that the malarial diagnosis is usually made on dried and stained films (which are in practice so much more convenient than wet films of fresh blood), a coloured plate of all phases of the parasite as seen in films stained by one or other of the Romanowsky modifications would be a useful and I think a very much appreciated addition to future editions; also a coloured plate of leucocytes similarly stained.

Amongst the imperfectly differentiated fevers the part played by bacilli of the colo-typhoid group is perhaps under-estimated. The chart of double continued fever of Hong-Kong which has appeared in all editions reminds one very much of typhoid or paratyphoid with a relapse, or as occurring in China it reminds one perhaps still more forcibly of the initial fever met with in cases of *Schistosomum japonicum* infection. A differential leucocyte count in such a fever in China would have been most valuable: the giant urticarial eruptions are only present in a minority of such cases—their presence is a valuable guide but their absence means nothing. The advice however to treat all doubtful fevers as if they were cases of typhoid is advice which all practitioners, more especially those new to the Tropics and the bugbear of uncertain fevers, should take to heart.

The chapters upon plague, leishmaniasis, trypanosomiasis, leprosy, yaws, yellow fever and dengue are remarkably complete and seem to exhaust everything there is to be said about them. Reference is made to Plimmer and Thompson's successful employment of antimony tartarate injections into rats infected with the non-pathogenic *Trypanosomum lewisi*, whereas the successful results were obtained by Plimmer and Thomson and upon rats infected with the highly pathogenic strains of *T. evansii* and *T. brucei* (see *Proceedings of the Royal Society*, B, vol. 80).

Pellagra and beri-beri are very fully gone into and the theories of their causation very fairly discussed. Together with epidemic dropsy they make up a section all by themselves entitled "General Diseases of Undetermined Nature." Rat-bite diseases which used to occupy the place of pellagra in this section are now classed amongst the fevers.

The usual diagrammatic representation of the cysts of entamœbæ, flagellates

and ciliates conveys rather a poor conception of these cysts as they are really seen; here again a coloured plate would be invaluable representing these cysts all under the same degree of magnification and stained by a commonly used clinical stain such as iodine.

To anyone who has successfully employed Cox's continuous intravenous normal saline transfusion, or, what is still better, this transfusion preceded by Roger's hypertonic transfusion, both given slowly through Cox's very ingenious apparatus, in cases of cholera, there will be regret that such a valuable means of combating this terrible disease receives so little notice.

Para-cholera is not referred to, yet bacteriologists frequently find Koch's vibrio absent in cases of what clinically resemble cholera both in type and severity; other organisms have been found in such cases and variously designated. It seems likely that in future our standard literature will have to recognize para-cholera just as it has already recognized paratyphoid.

The most outstanding new feature of scientific interest in the section of animal parasites is the recent work by Leiper upon the development of schistosomes through the intermediary of certain species of freshwater snails. An excellent help to diagnosis is the addition of photomicrographs of several intestinal ova; most of the more common ova are so illustrated, but so excellent and useful are they that one wishes the series had been made more extensive.

There is a useful appendix upon protozoa and in the body of the book useful guiding tables for the identification of species of mosquitoes and other insects, but the work lacks a chapter upon poisonous snakes and insects, and the more common food and plant poisons met with in tropical climates.

The field covered is an extensive one, yet every chapter may be considered to be a complete monograph of its subject. Clinicians, investigators and teachers will all alike find practical help and advice of the best kind. One wishes there were more medical works like it, handy sized volumes containing everything that really matters in all aspects of their subjects.

J. A. T.

Journal
of the
Royal Army Medical Corps.

Original Communications.

THE SYMPTOMS OF ACUTE CEREBELLAR INJURIES
AS OBSERVED IN WARFARE.

BY LIEUTENANT-COLONEL GORDON HOLMES.

Royal Army Medical Corps.

THE functional defects which are produced by injury or disease of the cerebellum have been described by many physiologists and clinicians, and almost innumerable attempts have been made to analyse and solve their significance and thereby determine the normal functions of this organ. But there is still a remarkable divergence between the symptoms attributed to lesions of the cerebellum in man in various text-books and monographs and the phenomena which physiologists have observed after its injury or ablation in animals. It is, however, obvious that a close correspondence must be established between them before clinical experience can contribute to the solution of the physiological significance of the cerebellum, and before we can determine the part which this plays in the human nervous mechanism.

The opportunity of making uncomplicated clinical observations is rare in civil life, since acute lesions of the cerebellum, comparable with those produced by physiologists, are uncommon; tumours and abscesses which develop in it are very liable to compress or to influence the functions of other parts; softenings and hæmorrhages are rarely wholly limited to it, and the degenerative and atrophic diseases which involve it practically never affect it alone. In warfare, on the other hand, wounds limited to the cerebellum and injuries of it of different extent and localization can be frequently observed. During the present War I have been able to examine over forty men in whom it had been injured, but as wounds of this region of the head are notoriously serious a certain number died early, in others the symptoms were only slight or transient, and many were of

necessity evacuated to England within a short time of the infliction of the injury. Twenty-one patients in whom the symptoms were pronounced remained, however, under observation sufficiently long to permit repeated examination and investigation. In several of these the wounds had healed and they were able to leave bed and walk before they were transferred; some of the more serious cases in fact remained under observation for two to three months.

My investigations have been consequently made chiefly in the early and acute stages of injuries of the cerebellum, but in many cases the recovery of function, or "compensation," could be also studied. I was particularly fortunate in being able to examine, before this paper was completed, two men in whom the lesions were of much longer standing. One, in an attempt to commit suicide eight years previously, had shot himself through his mouth and produced extensive destruction of one lateral lobe of the cerebellum, in which fragments of metal still remained. The other had been wounded by a fragment of shell-casing twenty months previously and had been trephined over one lateral lobe. Both patients still presented symptoms of cerebellar disturbance, but unfortunately the second man had developed signs of disseminated sclerosis. In a third case, which also came under my observation, the characteristic symptoms of a very severe unilateral cerebellar lesion had come on suddenly while he was under heavy gun fire. I have not included these three cases in my series, but I have been able to control many observations made in acute cases on them. My observations have been made, therefore, on injuries which resemble closely those on which the classical physiological descriptions are based, and it will consequently not be surprising that a close similarity exists between them. The chief divergencies probably depend on the position of the subject in the phylogenetic scale, and on the relative importance or subordination of the cerebellum in the nervous system of different animals.

In the subsequent pages it will be my aim to describe those disturbances of function which constitute the symptoms of recent cerebellar lesions as objectively as possible, and to attempt to analyse complex symptoms into their simpler components. Names and terms applied to symptoms will be employed as rarely as possible, and as the defects of function can be often most easily understood by observing abnormalities in the ordinary or spontaneous activities of the affected parts, clinical tests have been made use of only sparingly or have been supplemented by further observations.

It is, however, impossible to deal with this subject without relying largely on Babinski's masterly analysis of cerebellar symptoms and on the careful descriptive work of other neurologists, especially André-Thomas, who has also attempted a valuable correlation of these clinical symptoms with the disturbances that occur in animals after experimental injury. If

the references to their work are incomplete it must be attributed to the circumstances under which this contribution has been written.

In the majority of my patients who survived, the lesions were unilateral and involved only, or chiefly, one lateral lobe of the cerebellum; the descriptions of the resulting symptoms will be consequently based largely on these cases. Certain patients with extensive bilateral lesions were, however, also observed.

UNILATERAL LESIONS OF THE CEREBELLUM.

(1) *Disturbance of Tone.*

The effects of cerebellar injuries fall almost exclusively upon the motor system, and in the early stages of an acute lesion one of the most prominent symptoms is loss or diminution of tone in the muscles of the limbs, and to a less extent in those of the trunk, of the same side.

If a case in which there is an extensive unilateral lesion be examined within the first week or two, one of the most striking features is the flabbiness of the muscles of the homolateral arm to palpation; as compared with those of the opposite side they are more easily compressed and displaced transversely, and they can be stretched or elongated to a greater extent without any discomfort to the patient. This is obviously the reason why the limbs often assume unnatural attitudes or are placed in postures which the patient would tend to avoid, in a normal limb. Not infrequently, for instance, the hand may be observed lying for long periods prone on the bed with the fingers fully straightened out or even hyperextended, although this unnatural attitude can be easily corrected; and this is probably the explanation of the fact, that on attempting to rise into the sitting position in bed the patients occasionally help themselves by throwing their weight on the dorsum of the affected hand, so that the fingers and wrist are overflexed to an extent that would be uncomfortable or even painful in the normal limb. An officer, for instance, who was dull and restless for a few days afterwards complained that the knuckles and the wrist of his affected hand were sore, owing to the fact that in attempting to sit up in bed he usually placed this hand under him in the flexed position. This phenomenon cannot be attributed to loss of sensation, since repeated examinations have failed to reveal alteration in any of its modalities; it is analogous to the failure to correct instantly unnatural attitudes of the limbs, which Luciani has described after partial or total ablation of the cerebellum in animals.

If in such a patient both forearms are held vertically by the observer the wrist of the affected side usually falls passively into a position of extreme flexion, while in the normal limb the wrist is not allowed to become more than semiflexed owing to the tone of its extensor muscles (fig. 1). Similarly if as the patient lies in bed his arms are fully abducted and rotated out-

wards so that his hands lie behind his head, the affected wrist is more fully extended by its own weight than is its fellow, and the arm is often excessively rotated too.

When such a limb is handled and moved about passively it is at once obvious that there is loss of that slight but definite resistance that normal muscles offer to stretching. Further, if either the arms or the legs are seized and shaken it is found that the more distal segments of the affected limbs flop and swing about in an unnatural inert manner like the arm of a flail. This can be easily seen, but the abrupt jar which the arrest of the freely swinging segments communicates to the observer's hand is often even more unmistakable. Another striking feature brought out by this manoeuvre is, that while the oscillations of the distal segments of the normal limb are limited by the elastic tension of the muscles that are

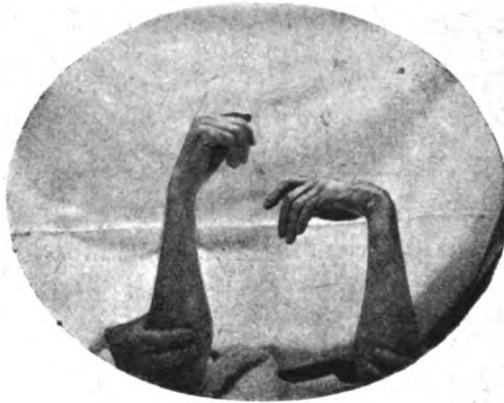


FIG. 1.—A case of extensive injury of the left side of the cerebellum; photograph taken one week after the infliction of the wound. When the forearms were held vertically the left wrist flexed under the influence of gravity much more than the right.

stretched, those of the other limb can be felt to swing till the joints "lock," and their bony and ligamentous structures prevent their further movement. This "locking" of the joints can be most easily felt at the wrist, elbow, and the ankle. There is never, however, any evidence of articular or ligamentous relaxation which permits a greater range of absolute movement, such as occurs in *tabes dorsalis*.

The same phenomena may be observed by rotating or otherwise suddenly displacing the patient's whole body when he can stand erect, for the affected arm swings about inertly as though it were only tied to the shoulder by a string. (André-Thomas.)

In rapid voluntary movement, too, an excessive passive swing at certain joints not directly concerned in the action can be often observed. When for instance the patient is asked to flex and extend his supported elbows as quickly as possible, as in testing for *adiadochokinesis*, the affected wrist

is successively overflexed and overextended owing to the momentum of the movement, so that the hand is flung against the shoulder or towards the bed. The fact that in this test the affected elbow is often raised from its support by the momentum of the flexing forearm is also due to deficient tension in those muscles that should fix the shoulder-joint.

And if the forearms are seized by the observer, and suddenly flipped as if he were cracking a whip, the wrists flex passively, but while the normal hand is immediately extended again owing to the elasticity of its extensors, the affected one remains flexed or only swings inertly. This may be seen at the ankle too if the relaxed leg is similarly jerked and arrested abruptly. Finally, if a patient in this stage holds his two arms horizontally outstretched and the normal limb is gently tapped by the observer's fingers, it is but little displaced and immediately regains its original position, but the affected arm swings more widely as a result of each blow, offers less resistance to displacement, is arrested less abruptly, and is slower in its return (André-Thomas). In this test the displacement is generally due to movement at the shoulder, but if the hand is more forcibly tapped the wrist and the elbow often flex too.

This diminution in elastic resistance of muscles to stretching can be often observed directly. If the fingers are seized and passively extended at the same time as the wrist they can be easily, and without the observer experiencing any resistance, bent back till further movement becomes impossible owing to the conformation of the joints and the tension on their ligaments; and even in this position the patient does not experience the dull pain or discomfort in the overstretched flexor muscles which he suffers when the unaffected wrist and fingers are forcibly extended to the same degree. This may be also observed at the elbow, shoulder, and in the joints of the lower limb. The affected heel can be for instance easily brought into apposition with the buttock, or the thigh can be so fully flexed that the knee touches the chest (fig. 2). Consequently, though the maximum possible range of passive movement may not be increased, the normal resistance offered to it by the muscles when they are passively elongated is deficient, and definite resistance is felt only when the rigid ligaments or the apposed bones restrict the movements. As a rule this diminished elasticity of the muscles becomes more obvious about five to ten days after the infliction of the wound, and in cases of severe injury it may persist for several weeks at least.

We therefore find on palpation, passive movement, shaking and tapping of the affected limbs, that their muscles are soft and flabby, and that their tension, which normally tends to oppose passive movement and prevent that unrestricted swinging under the influence of gravity or displacement of their different segments, such as occurs in a hinged skeleton, is diminished. In other words, there is loss of that active tension which

distinguishes normal muscles and is independent of their length, that is known as *tone*.

This flabby hypotonic state of the muscles suggested the examination of their reaction to direct percussion. This was done in several cases but no definite difference could be detected.

When an extensive unilateral lesion of the cerebellum exists this state of hypotonia is always limited to the same side, but it is usually more pronounced, or at least more easily demonstrated, in the upper than in the lower limb. Distal and proximal muscles are involved to relatively the same degree. It is less easy to demonstrate in the trunk muscles, but here too



FIG. 2.—A case of severe injury of the right lateral lobe and of the right side of the vermis, ten weeks after the infliction of the wound. The right thigh can be fully flexed on to the trunk, the heel placed on the buttock, and the foot much dorsiflexed with the exertion of very little power.

the stretching of those of the side of the lesion offers less resistance, as the patient sits or stands, than those of the unaffected side. It does not produce any appreciable asymmetry or other change in the face. In smaller lesions it is generally demonstrable in both the upper and lower limbs, but it is less pronounced, especially in the latter.

Its distribution, especially in slight cases, is a question of considerable importance in view of the conclusions arrived at by André-Thomas and Durupt from experimental work, which Thomas attempts to support by certain clinical observations. These authors have described as a result of small limited lesions of the cerebellum an affection of the tone of certain

muscles or groups of muscles only, so that a condition of *anisosthenia* or loss of tone in some muscles and relative hypertonicity of their antagonists, results. It is to this disturbance that André-Thomas attributes many of the symptoms of cerebellar lesions which occur in man.

Though I have carefully searched for this condition in the majority of my patients, I have been unable to find any support for his observations. In the early stages of extensive lesions the atonia is certainly uniform, no matter what method is relied upon for its demonstration; and even during recovery, as well as in cases of circumscribed injuries, I have been unable to discover that it is ever limited to certain muscles. In my notes of one case, it is true, it is recorded that on the twenty-seventh day "there is perhaps relative hypertonicity of the adductors and inward rotators of the shoulder, and of the supinators," but in both the earlier and later notes it is emphasized that the hypotonia was general and uniform in the affected limbs. If such *anisosthenia* existed commonly it would probably be most obvious in cases with local and restricted lesions of the cerebellum; but though I have seen many of these I could find no evidence of it.

The one common symptom that might be advanced in support of Thomas's thesis is the tendency to deviation of the unsupported limbs, and the frequent error in projection revealed by Bárány's pointing test; but these signs will be dealt with later.

In cases which remained under observation for some time the hypotonia diminished gradually and uniformly, but in all it persisted and was easily demonstrable till the patients were transferred to England. In three cases it was still pronounced seventy-one, seventy-eight, and ninety days respectively after the infliction of the wound. Even in the case in which the injury dated from eight years previously the homolateral arm and leg swung about more inertly, and the patient, who was an educated man, described them as "floppier" than his normal limbs.

(2) *Voluntary Movement.*

(A) *Strength.*—The flabby toneless limbs of the affected side give an unmistakable impression of feebleness when they are handled or examined, and many patients have spontaneously complained that they are "weaker" or "more useless," or that they "have not nearly so much power in them," as they formerly had, or as those of the opposite side still possess. This impression is, however, not wholly borne out by examination, for the degree of paresis is always moderate. But there can be no doubt that during the earlier stages of every extensive injury of one side of the cerebellum the strength of all the movements of the limbs of this side is definitely reduced, even when concomitant lesions of the cerebrum and of the chief motor paths can be excluded with certainty. Both the proximal and the distal muscles are affected and as a rule the former

appear on the whole relatively weaker. The feebleness is always more pronounced in the arm than in the leg.

This feebleness is usually obvious even when the patient attempts any movement that requires the exertion of power, since more effort is apparently necessary to perform it. This may be seen when he is asked to hold his arms horizontally outstretched or when he tries to raise an object of moderate weight, and the longer the attempt is prolonged the more striking is his difficulty.

When in such cases the strength of various movements, as grasping, flexion and extension of the elbow, flexion of the hip, etc., is tested and compared with that of the corresponding muscles of the opposite side, the difference is usually definite and is approximately proportional in all movements of one limb. This can be easily demonstrated by dynamometric readings. With Dr. Castex's dynamometric apparatus, which he kindly lent me, I obtained the following measurements of the maximal force of several movements of the two sides, in two cases of severe unilateral injury.

	Case 1 (thirty days)		Case 2 (seventeen days)	
	Unaffected side (R.)	Affected side (L.)	Unaffected side (L.)	Affected side (R.)
Grasp	12.4	5.8	17	10.7
Flexion of elbow ..	26.2	15.3	27.3	16
Extension of elbow ..	11.8	5.2	—	—
Supination ..	10	5.2	25	14.5
Pronation ..	20	14.5	31	25.5
Extension of ankle ..	17	15	—	—

In Case 1 there was a penetrating wound, from which a piece of shell casing was removed, over the middle of the left lobus gracilis; a considerable amount of softened cerebellar tissue escaped at the operation, and it is probable that the nucleus dentatus was involved. Healing occurred rapidly without any hernia formation.

In Case 2 a large fragment of metal entered over the lateral third of the right lobus gracilis and was removed from the mesial portion of this lateral lobe. There was considerable destruction of cerebellum and a hernia developed, but the patient eventually recovered.

These figures represent the average of several readings for each movement. Case 1 was examined on the thirtieth, Case 2 on the seventeenth day after the infliction of the wound.

The lower records on the affected side may be partly attributed to the difficulty and awkwardness of this hand in holding the instrument; this may be a factor especially when the power of grasping is tested by the ordinary dynamometer, but it can have little influence in estimating the power of other movements by Dr. Castex's apparatus.

When a series of records is made it is also found that the affected limbs tire more quickly than their fellows, and the power exerted by

the contracting muscles then diminishes considerably. It is often obvious too, that when the patient is asked to grasp the observer's hand as strongly as possible, the grasp of the affected limb is less continuous and less well maintained than of the other; but this is not always so. It can be even more easily demonstrated when the patient attempts to depress the observer's hand with his extended arm; the exertion of power can be felt to be jerky and more or less intermittent. In other movements, too, a similar irregularity in the exertion of power can be often detected, and if the lesion is severe the contraction of the muscles in every action against resistance may be less well maintained.

The sudden unexpected relaxations of contracting muscles that sometimes occur are closely allied to this; in standing, for instance, the leg of the affected side occasionally gives way under the patient, and some men complained that they were afraid to use the affected hand in taking food and in similar actions, as any object they grasp by it is liable to fall suddenly from it. But even when a limb is definitely weak in active movements its static strength—that is, the resistance it can offer to displacements which the patient attempts to resist voluntarily—is generally unaffected. If, for instance, he attempts to keep his elbows or his fingers flexed when the observer tries to extend them, the power necessary to overcome his resistance is approximately the same on the two sides.

Another feature, which is often very striking when the cerebellar injury is severe, is the apparent reluctance of the patient to move the affected arm. This may be frequently seen to lie for long periods in the same attitude, and though he may frequently bring the opposite hand to his face, arrange the bedclothes with it, etc., he more rarely employs the affected one. And when food or any object is offered to him it is almost always with the unaffected limb that he takes it. This may be partly due to the patient's knowledge that he cannot use the affected limb as efficiently or as safely as the other; but it is impossible to observe a patient with a recent cerebellar injury for any time without coming to the conclusion that there is an inherent reluctance to move the limb unless it is necessary. Even if his two hands are pricked by a pin the patient withdraws the affected limb less readily and less briskly than the normal. I could, however, never observe any difference between the reflex withdrawal of the limbs of the two sides from a noxious or painful stimulus. In two cases it was noticed that during the early stage of chloroform anæsthesia the patient in struggling moved only or chiefly his normal limbs.

Further, in the early stages of a cerebellar injury there is almost always a marked slowness of the movements of the affected limbs, and especially of the arm, as compared with that of the other side. If a rod is held in front of the patient equally distant from his two hands and he is asked to take hold of it with both, it is found that the movement starts

more slowly on the affected side, and that this limb seizes the rod an appreciable time after its fellow. Undoubtedly the slowness in reaching the object is partly due to the irregularity of voluntary movement which is generally known as "ataxia," but this is certainly not its only cause. This may be seen when the observer's hands are placed in the patient's, and he is asked to grasp them firmly at a given signal; the slowness of the affected limb in starting the action and in developing full power is often unmistakable. It matters not whether the patient attempts such simultaneous actions of the two limbs at the rate he chooses, or whether he is asked to do them as quickly as possible, the affected limb lags behind the other. In the early stages of severe injuries it is in fact difficult to make him hurry in movements of the affected limb.

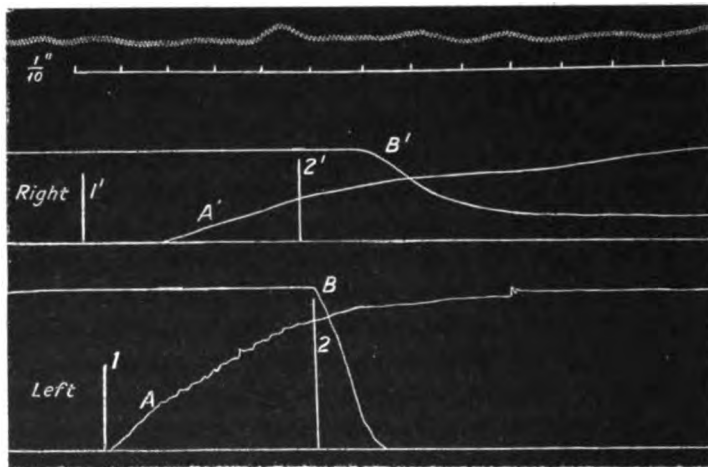


FIG. 3.—From a case of moderately severe injury to the right lateral lobe ten days after the infliction of the wound. The patient was asked to grasp simultaneously with his two hands against two equal springs. 1 and 1' represent the simultaneous ordinates, A and A' the lines traced on a rapidly revolving drum. The drum was allowed to complete one revolution and a signal to relax was then given; 2 and 2' represent the simultaneous ordinates, and B and B' the curves traced by the released springs. Time by a tuning-fork of 128 vibrations per second.

Even in cases of less severe injury in which there was no obvious loss of power, this slowness in movement is also apparent. It may be partly attributed to the fact that experience has taught the patient that the more rapidly he attempts to make a movement the less well can he control it; but that this is not the whole explanation can be easily seen by the investigation of simple movements, especially by the graphic method. Fig. 3 reproduces the tracings obtained when a patient with a right-sided lesion was asked to grasp simultaneously on a given signal against two carefully graded and equal steel balance springs. With his left hand, A, he started immediately on the signal being given (1 and 1') and attained full power

in about five-tenths of a second; but in his right hand, A', there was a delay of two-tenths of a second in starting the contraction, and the exertion of power did not attain its maximum till one second later. Further, the power exerted was little more than one-half that developed by the left hand.

When the signal to relax was given (2 and 2'), his left hand opened at once and the tracing, B, quickly reached the base line, but on the right side relaxation did not commence till about one-seventh of a second later, and the fall of the tracing to the base line was much more gradual even though the extension of the fingers was aided by the tension of the extended spring. The same features may be seen in the tracing reproduced in fig. 4; here the right hand, which was affected, was less slow in

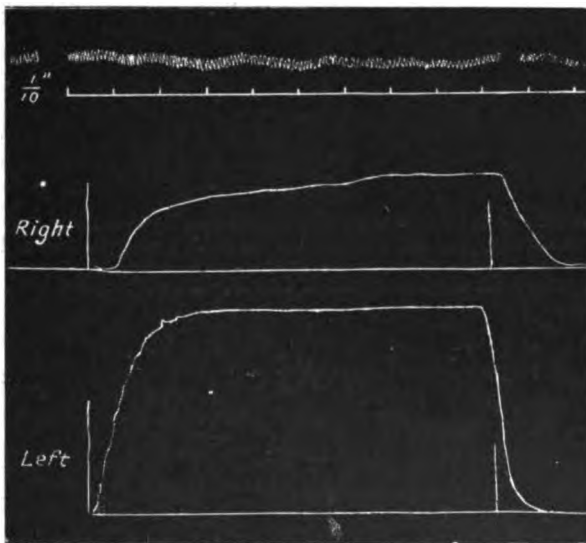


FIG. 4.—Tracings of simultaneous grasps obtained as in fig. 3. From a case of right-sided injury fourteen days after the infliction of the wound. Legends as in fig. 3.

initiating contraction, but the full power of grasp was only attained after six-tenths of a second, and its strength was only half that of the left hand. There was also an appreciable delay in commencing relaxation and a definite slowness in its completion.

In fig. 5 the same condition is seen when a third patient with a right-sided lesion attempted to flex his elbows simultaneously against resistance, and later relax on a given signal; in this case delay in initiating, and slowness in effecting, relaxation were the most prominent features.

The same facts may be easily observed in other movements of the

affected limbs in the majority of, if not in all, patients with severe and moderate unilateral injuries. When, however, corresponding muscles of the two limbs are stimulated simultaneously by a faradic current no slowness in either their contractions or relaxations can be detected (fig. 6);

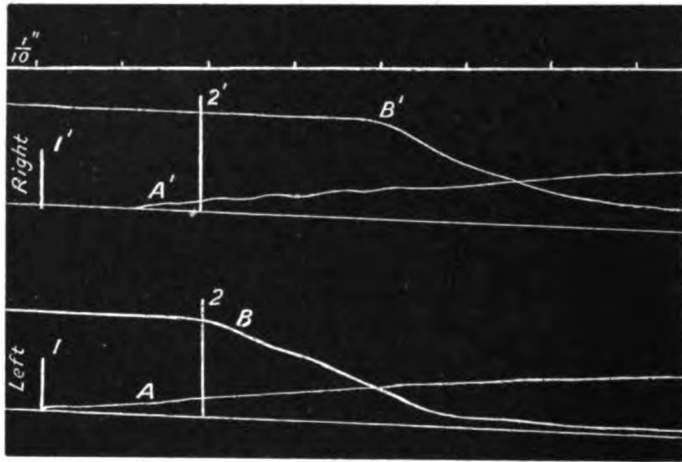


FIG. 5.—From a case of injury of the right lateral lobe and probably also of the vermis of the cerebellum, six weeks after the infliction of the wound. Tracings, A and A', of an attempt to flex his two elbows simultaneously against the resistance of two equal springs, and later to relax them simultaneously on a given signal B and B'. 1 and 1' and 2 and 2' represent the simultaneous ordinates.

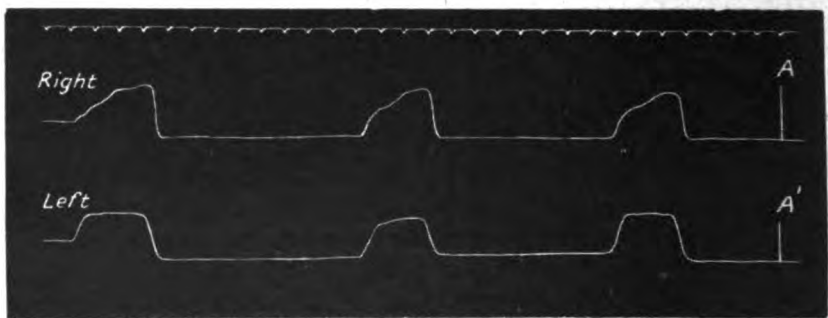


FIG. 6.—Tracings obtained from tambours placed on the tendons of the flexors of the fingers of the right and left hands when these were stimulated simultaneously by a faradic current, in a patient with an extensive right-sided cerebellar injury. There was in this patient a considerable delay in the initiation of both voluntary contraction and relaxation of these muscles. A and A' represent the corresponding ordinates. Time in fifths of a second. Read from left to right.

nor is there any difference in the latent periods of their contractions when these are excited reflexly.

We consequently find that (1) a delay in initiating muscular contractions; (2) a slowness in attaining the exertion of full power; (3) a delay

in commencing relaxation; and (4) a slowness in effecting relaxation, are among the symptoms produced by cerebellar lesions. As a rule, there is delay and slowness in both contraction and relaxation, but occasionally only contraction, or more commonly relaxation, is slower than it is in the normal limb; a slowness in relaxation is probably the most common.

The affected limb also tires more rapidly than the normal, especially in movements that demand power and in those made against resistance.

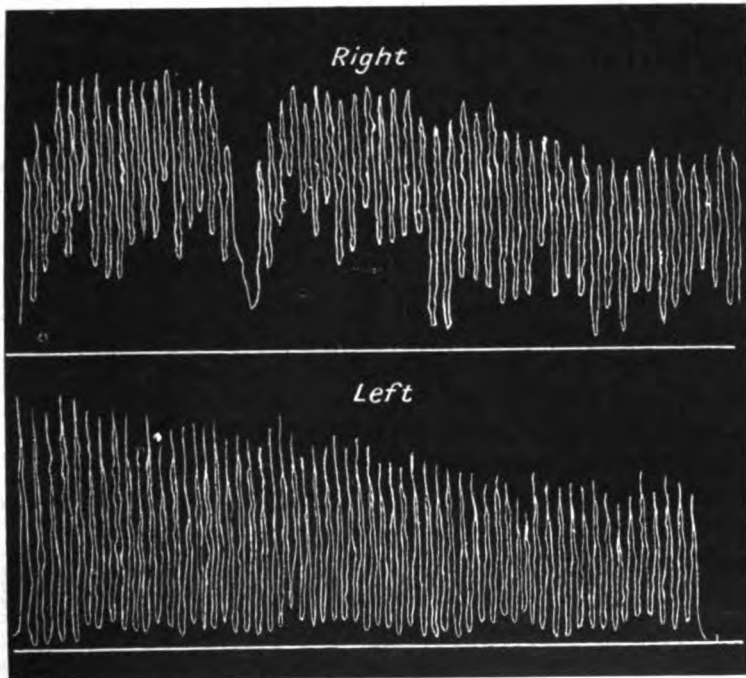


FIG. 7.—From a case with an extensive right-sided lesion five weeks after the onset. The patient was asked to compress and release a strong spring as quickly as he could with his left and his right hands in succession; the movements of the spring were recorded in a slowly revolving drum. The tracing obtained from the left hand shows only evidence of fatigue; that from the right hand is very irregular and frequently did not reach the abscissa, owing to the patient commencing to flex his fingers again before he had fully relaxed his grasp.

This can be well seen if the patient is made to hold his arms outstretched horizontally in front of him, or to keep his legs elevated from the bed. At first the affected limb is usually held very steadily, but it tires rapidly, and then a coarse jerky tremor often appears, owing chiefly to his voluntary attempts to regain the position from which the tired limb gradually falls away. The tendency of the affected limbs to tire more rapidly can be seen in most ergographic tracings. In these the range of movement is also generally smaller and more irregular,

while its rate is slower. Occasionally, however, as in fig. 7, the most striking feature is due to the fact that when the patient attempted to perform such movements against resistance as quickly as he could a second contraction often occurs before the previous relaxation was complete, and consequently in many excursions the tracing did not reach the base line. In this patient there was an obvious delay and slowness in starting and in completing the relaxation of contracting muscles.

The weakness of the limbs of the affected side is always most evident in the early stages of the cerebellar injury and diminishes gradually. In several of the cases in which the lesion was small or moderate in size no difference could be detected in the power of the homologous limbs after two to three weeks, but in more severe injuries the paresis is more persistent. In the two cases referred to above in which dynamometric readings were made, it was still obvious in each upper limb eighty and seventy days respectively after the infliction of the wound, but the lower limbs were then equally strong. Even when their strength had recovered the affected limbs still remained appreciably slower in movement than the normal.

This form of weakness due to cerebellar wounds is distinguished from that produced by lesions of the cortical motor area or of the cortico-spinal tracts by its homolaterality, by its uniformity and the approximately equal affection of all groups of muscles, by the fact that though all voluntary movements are weak none are limited in range, by the absence of the characteristic alterations in the reflexes, and by the fact that there is no tendency for rigidity or contractures to develop. The term *asthenia* introduced by Luciani is consequently more suitable for it than paresis.

(B) *Ataxia*.—But the most obvious sign of cerebellar disease is that irregularity in voluntary movement which is generally loosely described under the term “ataxia,” though physiologists and certain clinicians have tried to analyse it into simpler components.

This disturbance of voluntary movement may be most easily studied separately, as it occurs in the early and in the later stages of extensive lesions, since in the latter period the effects of cerebellar deficiency are complicated by the results of “compensation” by other parts of the nervous system, and by the voluntary efforts by which the patient attempts to control his disability.

In the early stages all movements of the limbs are affected, but the disturbance is more striking in the upper than in the lower extremity, and in complex than in simple movements. It must be emphasized that the control of movements by vision has no influence on their regularity, and that they are quite as “ataxic” when the patient’s eyes are open as when they are closed.

Let us assume we have a patient with a recent severe lesion of the right half of his cerebellum. When he is asked to touch an object with his left forefinger he does so promptly and accurately, and to reach it moves his hand in the most direct line practicable from the position in which it lay. He raises his right hand from the bed less promptly, and as soon as the limb is unsupported it sways unnecessarily and aimlessly at its more proximal joints, and during the movement his finger deviates from the direct course by which it could most easily reach its aim. Further, he rarely succeeds in touching the object at once, but usually brings his index to one or other side of it, and projects it too far or more rarely stops the movement too soon. Errors consequently occur in both the direction and in the range of its movement. If his elbow is fixed so that it is necessary for him to move only his forearm and hand, the irregularity and inaccuracy of the movement is less pronounced. Similarly, if when his arm is extended vertically or held outstretched in front of him, he is asked to bring his index finger to his nose, it is seen that his finger does not take the direct and shortest course, and instead of coming accurately to his nose it often strikes his chest, chin or forehead. Further, it is often brought to his face with undue force.

If an attempt is made to obtain from the patient his explanation of this irregularity of his movements he merely describes, if he happens to be intelligent, that which the observer has already noticed. One patient said: "I don't seem to have the power to do what I want to with my hand, though if I take hold of anything with it I can grip it all right. If I want to bring it to my mouth I only hit my eye with it; it is drunk; it won't go straight." Another man described his disability by the statement: "I don't feel that I can get the right direction with this arm"; while a third patient when examined in a later stage (ten weeks after the infliction of the injury) complained that he "could not pull the arm up quickly enough," and therefore brought his finger beyond any point he wished to touch.

This irregularity in direction and range is always more marked in rapid than in slow movements; in fact when the patient is asked to execute the movement slowly, or is urged not to hurry, there may be little or no obvious disturbance. Further, simple actions which require movement at one joint only may be fairly accurately performed, though complex actions are irregular and ataxic; the patient can succeed much better in touching with either his finger or toe an object that he can reach with the limb extended than when movements at the elbow, knee or other joints are also necessary.

The movements of all segments of the limbs are generally affected, and those of the distal joints are in fact usually the most seriously disturbed. If, when the patient's eyes are closed, an unknown object is placed in his

hands and he is asked to identify it, it may be seen that he handles it and moves his fingers over it irregularly and awkwardly; often he only grasps it firmly and rubs it between his finger and thumb. The affection of his fingers is better demonstrated and more easily analysed if he is asked to bring the tip of each finger in succession to the top of his thumb; then he frequently fails to place finger and thumb in correct apposition, the finger often slides along the side of his thumb, and the relative degree of movement at the different joints of the finger are not so regular or appropriate as in the normal hand; sometimes only the metacarpophalangeal joint is flexed, or the bending of the interphalangeal joints may be excessive. The rate of movement, too, is not uniform, but is often jerky and intermittent. Further, while in the normal hand each finger is flexed separately, on the affected side all fingers are frequently flexed at the same time, though he wishes to bring one finger only to his thumb.

When this disturbance of movement is more carefully examined several factors can be distinguished in it. These may be most easily considered separately, though the relative prominence of each may vary in different cases and even in different stages of the one case.

(i) *Decomposition of Movement*.—If we again ask the patient as he lies in bed to extend his arm vertically over his face and then bring his forefinger to his nose, it is seen that instead of depressing his arm and flexing his elbow simultaneously, he first brings his elbow towards the bed and only when it is there or near it does he approach his finger to his nose by flexing his elbow. In other words, he “decomposes” the movement into its separate elements (Babinski). This may be seen in various other actions of both the upper and lower limbs. One patient, for instance, when asked to place the heel of his affected side on his opposite knee always dragged the heel along the bed till it reached the knee and then only raised it to the proper height; other patients on the contrary have raised the heel unnecessarily before beginning to flex the knee. Or if the patient be asked, as he lies on his back, to bring his heel to his buttock, he may do it in two stages: first flexing his hip and only later flexing his knee. Similarly, if when able to leave bed he attempts to place his foot on a chair, he frequently raises the foot too high by flexion of his hip before he bends his knee.

In other words, the patient tends to perform the separate movements that constitute an act “by numbers,” as in a gymnasium or in military drill. This is the condition which Babinski has termed *asynergia*; he has defined it as “the inability to accomplish simultaneously the various movements that constitute an act.”

The question arises whether this decomposition of movement is voluntary or not. I know of no test that can settle this point directly, but the fact that it may be observed in its extremest form when the

patient, still in a dull and stupid state on recovering from the early general effects of a wound, or after an operation which has entailed further damage of the cerebellum, first makes purposive movements, suggests strongly that it is not always a willed device by which he attempts to diminish the inaccuracy of his limbs.

(ii) *Asynergia*.—The term asynergia can be more correctly restricted to the absence or disturbance of that proper synergic association in the contraction of agonists, antagonists and fixating muscles, which assures that the different components of an act follow in proper sequence, at the proper moment and are of the proper degree, so that the act is executed accurately and with the least possible expenditure of energy.

When the fingers are flexed the extensors of the wrist normally contract synergically with appropriate force in order to prevent simultaneous flexion of the wrist, but when a patient with a cerebellar lesion grasps a small object quickly it often happens that the wrist of the affected side is extended excessively or too early, so that the hand is bent backwards when the fingers are but half flexed: the normal co-operation of the contracting muscles, on which the accuracy and precision of the action depends, is consequently disturbed. This can be often seen more definitely when the patient flexes and extends his fingers rapidly; then the wrist often flexes as he brings his fingers into his palm, or extends too much as he straightens them, or the finger movements and the synergic wrist movements may be partly dissociated or inaccurately combined in time or in degree.

A disturbance of synergia, which should keep the legs extended and thus bring the centre of gravity of the body as near the pelvis as possible, is also the explanation of the fact that in attempting to rise from the supine position by flexion of the trunk upon the hips the heel of the affected side often rises from the bed (Babinski). Frequently, however, only the knee is raised by flexion of the hip on the trunk and the heel remains in the bed owing to failure of the normally associated contraction of the quadriceps extensor. Babinski has also shown that the cerebellar patient, when standing, often falls when he throws his head backwards, owing to his failure to bring his centre of gravity over his base by flexing his knees, and I have observed this in several cases. When asked to sit down on a low bed or stool he is also liable to fall backwards, as he again fails to adjust his balance by flexing his trunk on his hips. Other examples are seen in walking, as the affected arm generally hangs inertly by his side and does not swing forwards when he advances his opposite foot; and in the failure of his head and eyes to move simultaneously when he looks to one or the other side.

In the majority of such movements the contracting muscles (agonists) have to displace the limb or some of its segments against gravity, and

their antagonists only relax reciprocally; but in other actions, as when the elbow is fixed above his head and the patient brings his finger down to his nose, that is in the direction in which its weight would move it, the most important factor is the gradual relaxation of muscles which are the antagonists of the flexors of the elbow. The disturbance in the co-ordinated activity of agonists and antagonists suggested comparison of movements executed with and those performed against gravity, but though this was investigated in certain cases, as by making the patient bring his finger successively up to and down to his nose by merely bending his elbow, no significant difference could be detected.

(iii) *Dysmetria*.—Another striking abnormality in the affected limbs is the fact that the range and the force of their movements are not correctly adapted or proportioned to their aim; they are ill-measured or dysmetric (Luciani). In attempting to touch a point, for instance, the finger-tip often shoots past it, or more rarely the movement is arrested before it reaches it. And in bringing his finger to his nose, the patient may either strike his face too forcibly, or arrest the movement momentarily before he reaches it. Similarly, when asked to grasp an object, he throws his arm forward with excessive force, opens his hand unnecessarily widely, and finally seizes it too roughly and too forcibly. In other words, neither the range nor the force of the movement is accurately adapted to its aim.

This is particularly prominent in quick movements; when the movement is slow, and can be closely watched by the patient, it is more correctly graded, but even in slow and deliberate actions, as in carrying out Bárány's pointing test, dysmetria may be seen. Often, too, as he makes a deliberate attempt to touch his nose, he allows his affected hand to flop heavily against his face, as though he were too lazy or careless to pull it up.

It is noteworthy that as has been pointed out by other observers (Babinski, André-Thomas), the range of movement is most commonly excessive, but in the early stages of acute cerebellar lesions it happens frequently that the movement is arrested or slowed down before the point the patient wishes to attain is reached, and the hand or foot is then brought to it by a series of slow deliberate jerks. In a few cases the most striking abnormality when the patient tried to take hold of an object was the tendency of the affected hand to stop short of it, pause for a moment, and then swoop down on it with excessive force. In other actions, too, as when he tries to bring the tips of his fingers successively to the top of his thumb, the range of movement is often too small rather than excessive.

This dysmetria is particularly pronounced in the attempts to perform accurate movements against resistance, as when he tries to raise a moderate weight, or to release his finger from the observer's grasp and bring it directly to the tip of his nose. It is under such conditions that

the difficulty in arresting a movement that was correctly initiated is most obvious. These facts suggest that dysmetria bears a close relation to the symptoms described under the "rebound phenomena."

(iv) *Tremor*.—Voluntary movement is also often complicated and disturbed by the occurrence of tremor in the moving limb, but this is not such a prominent factor in the early as it is in the later stages of a cerebellar lesion. In the notes on many of my more serious cases it is stated definitely that there was no tremor.

Frequently, however, and especially in quick movements, the finger or toe is approached at a fairly uniform rate to within a few inches of the point the patient wishes to touch, and is thence brought to it by a series of irregular brusque jerks, which to some degree resemble those of ordinary intention-tremor, though the pauses and interruptions of movement are usually less abrupt, and the projections more deliberate and larger in range. And even when the limb reaches the object for a time it is not held steadily in contact with it; after the patient has brought his finger to his nose, for instance, the tip of the latter is often intermittently depressed or displaced to one side or the other.

The coarser forms of tremor may be associated with dysmetria, the movement being arrested too soon, and the limb then approached to the object by a series of jerks; or it may be due to voluntary arrest of the primary movement and the subsequent attempts of the ataxic limb to reach its aim. It cannot be attributed wholly to these causes. When simple movements, as flexion or extension of the forearm or leg, are carefully observed, it may be often seen that the limb is moved in a series of irregular jerks, and that the tremulousness usually increases towards its completion when accuracy is most essential. It is occasionally possible by palpation of the muscles to detect an irregularity or discontinuity in their contractions. Occasionally, however, the movement seems to be interrupted by irregular intervention of the antagonists. Consequently, even from its commencement the movement is often irregular, and throughout its whole range it lacks the continuity and uniformity in rate which distinguish ordinary voluntary displacements of a limb.

(v) *Deviations from the line of movement*.—It has been already stated that the irregularity of movement in the early stages of a cerebellar lesion are partly due to the fact that the limb deviates from the direct line, and is not moved along the shortest course that it should naturally take; but this symptom needs more emphasis, as it has been overlooked by many clinicians who have studied chiefly the later effects of cerebellar injuries, or the symptoms of atrophic or degenerative diseases of this organ.

This deviation in movement was observed by Grainger Stewart and myself after the removal of tumours and surgical damage of the cerebellum, and I have seen it frequently since in similar cases. It is equally obvious

in recent gunshot injuries. In the early part of the movement the limb sways about in a purposeless manner as soon as it is raised from its support; during the movement it deviates from its proper course, and towards its completion it does not come straight to the object it should touch or seize; in trying to touch his nose, his finger, for instance, often comes to his cheek or eye. One patient declared that when he attempted to feed himself with the affected hand it was frequently to his ear that he brought the food, and another that he could not use this hand in smoking, as he was afraid of putting the cigarette into his eye. This error cannot be attributed to dysmetria, or to properly directed movements executed with ill-graded force, as the hand which the patient wishes to bring to his nose often comes to his cheek or eye even when it is moved from directly in front of his face.

The slow swaying at the commencement of the movement is most pronounced when the limb is atonic, and it seems to be directly associated with loss of tone in the muscles that should fix its proximal joints; it often suggests an asthenic or paretic condition. But the deviation from the direct course during the movement and the failure to bring his hand or foot to the correct point, must be attributed to disturbance in the regulation of the force and sequence of the contractions of the different muscles employed in the act. Decomposition of a movement naturally produces errors in its direction, and a similar disturbance in the co-operation of the various muscles, even though it does not cause obvious decomposition may lead to deviations from the correct direction.

It is an interesting point whether there is any constancy in the direction in which the limb deviates during and at the completion of the movement, and if so what its relation is to the direction in which it tends to deviate when unsupported and in Bárány's pointing test. No regularity in the direction of the deviation can, however, be observed in early cases, though later the frequent tendency to spontaneous deviation often influences the direction of the error. One man, twenty months after the infliction of a cerebellar wound but who now presented symptoms of disseminated sclerosis as well, in attempting to touch his nose when his eyes were closed always brought his forefinger to that side of it towards which his arm tended to deviate in Bárány's test, and the same fact was observed in another patient three months after he had been wounded. It is in such cases that Babinski rightly contrasts the failure of the cerebellar patient with that of the tabetic in attaining his aim.

After the first few weeks; according to the nature and the severity of the wound, these disturbances of voluntary movement begin to alter in character. When the patient raises his arm or leg the limb sways about less aimlessly, in movement its deviations from the correct direction are less obvious, and it generally reaches its aim more directly.

At the same time the tendency to decompose or "two-stage" movements is less common in simple actions, as in bringing his finger to his nose, though it can still be detected in more complex actions. The disturbances in the co-ordination of agonists, antagonists and synergic muscles also diminish; in closing his fingers quickly there is less tendency to over-extension or to flexion of the wrist, and the wrist and finger movements are more correctly associated when he rapidly extends or flexes the latter.

On the other hand, the deficient regulation of the range and force of movements, which has been described as *dysmetria*, persists or may be even more striking now. The arm is flung out from the shoulder and the hand tends to grasp every object with too much force. At this stage the range of movements is much more frequently excessive than short of its aim; *dysmetria* therefore generally takes the form of *hypermetria*. Movements consequently tend to be performed too abruptly and too forcibly, though they still start more slowly than those of the normal limb.

Now, however, voluntary correction begins to play a greater part; when the patient's movements and actions are carefully watched it may easily be seen that he tries to correct his errors. If on one occasion he overshoots his mark, in subsequent attempts he may stop short of it. The patient who stated that he could not pull up the affected arm quickly enough now began to arrest his finger short of his nose when he attempted to touch it, and then brought it in contact with it by a series of deliberate coarse jerks; and if the arm at first tended to strike his cheek or eye when the patient tried to bring his finger to his nose he now stops before he reaches his face and completes the action in the same intermittent, jerky fashion.

An irregularity in movement resembling intention-tremor is consequently a prominent feature at this stage. This cannot however be attributed wholly to the intervention of voluntary effort in order to control the errors, as even the jerks are irregular and inappropriate in range and force, though it is usually more pronounced the more rapidly the movement is performed and consequently the less opportunity the patient has to correct his errors voluntarily.

But in order to understand more fully these disturbances of voluntary movement it is necessary to investigate the symptoms included here in the rebound phenomenon, and to observe the affected limbs as the patient attempts to perform alternate movements rapidly with them.

(To be continued.)

RESULTS OBTAINED FROM THE USE OF ANTI-DYSENTERIC SERO-VACCINE IN THE FIELD, WITH REGARD TO THE REDUCTION OF CASE INCIDENCE.

By MAJOR H. GRAEME GIBSON.
Royal Army Medical Corps.

In a paper published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, June, 1917, dealing with the experimental work on, and the preparation of this vaccine, I stated that a trial of the vaccine under war conditions was contemplated. War Office sanction was obtained and the tests have now been carried out with encouraging results.

A test was arranged for in two spheres of operations and in each case the incidence of bacillary dysentery was diminished among the men inoculated with the vaccine.

From the fact that the inoculated and uninoculated men were men of the same battalions and even of the same platoons and so were exposed to exactly the same risk of infection, the reduction of the case incidence among the inoculated individuals is satisfactory and points to the value of this prophylactic measure.

The vaccine used was prepared by the same methods as described in the first paper [1] as far as the principles of the vaccine are concerned. There were some slight differences in the technique of the preparation which was in its earliest infancy when the former paper was written and has been improved upon since.

Two tests were arranged; one in the Near East, and a second on the Western Front.

Dealing with the test in the Near East first, while the total incidence of dysentery was not high, that occurring among the inoculated men was markedly less than that among the uninoculated. At the same time an exact mathematical comparison between the two groups of men, that is between the inoculated and uninoculated, is unfortunately not possible, as the experiment was not fully controlled. The following is the reason for this:—

To control effectively the results of inoculation it was necessary to take the uninoculated men in the test units and to observe the amount of dysentery among them over the same period as that among the inoculated men. The only efficient method of doing this was to take a nominal roll of the uninoculated men present with the units at the time that the inoculations were completed and to follow these men only over the observed period. This was not done and the only information I could obtain was the average number of inoculated men and the average number of uninoculated men present with the units for a period of eighteen weeks after inoculation had been completed. Now there is a certain amount of

wastage due to other causes than dysentery, and while there were no further inoculations done, which resulted in the strength of the inoculated men assuming a steady downward curve, the other side, i.e., the controls, were reinforced from time to time with fresh drafts and thus there were more men than are shown by the average strength who had been exposed to infection.

However, against this may be put the fact that while the inoculated men were exposed to infection over the whole period of eighteen weeks, owing to the wastage and reinforcement the uninoculated men, although there were more men present with the units than the figures indicate, individually were exposed to infection for a shorter time than the inoculated men. On this account although the results are not so accurate as they might otherwise have been they seem worth publishing in the meantime until others can be collected, which cannot be done until the return of the hot weather.

In this locality there have been every year two rises in the curve of the dysentery incidence among the troops:—

(a) That making its appearance at the commencement of the hot weather, and

(b) That which takes place in the autumn.

The men inoculated were given their two doses of the sero-vaccine (in one unit fifty-two per cent of the total strength were given two doses, and nineteen per cent of the total strength three doses) towards the end of the first rise in the curve. As it happened the autumn rise was not very well marked and was much lower than during the previous year.

The figures are too small to form a definite opinion on, but to my mind they certainly are encouraging. The officer in charge of the laboratory that dealt with the greater portion of the cases of dysentery which arose in these three test units gives his opinion in a report as follows:—

“The number of cases dealt with has been too small from which to draw safe conclusions, but it would appear that the inoculation has conferred a considerable measure of protection against bacterial dysenteric infection.”

In the three original test units the observed population at the time the inoculations took place was 2,700 men. Of these, 1,150 were inoculated and 1,550 were left uninoculated and served as controls. Observations were carried out over a period of eighteen weeks.

None of the inoculations caused any ill effects. In the majority of cases there was a general reaction noted which, as a rule, made its appearance on the same day as the inoculation took place and had passed off by the next day. The local reactions were, as a rule, quite mild and had passed off in forty-eight hours. The medical officer in charge of one of the units reported, “arm in nearly all cases fit for use in thirty-six hours.”

Among the inoculated men there occurred nine cases of dysentery; of

478 *Results from the Use of Anti-Dysenteric Sero-Vaccine*

these seven were diagnosed on clinical grounds and the infecting organism was recovered from two. One of these two men developed dysentery due to *Bacillus dysenteriae* Flexner five days after his second dose of vaccine, a time when, as I shall show later on in the paper, there seems reason to suspect very little immunity has yet been acquired. In the other case the infection was due to *B. dysenteriae* Shiga, and in this case the patient at the time of his admission to hospital did not show any agglutinin in his blood to the specific organism.

In addition there were two more cases of bacillary dysentery in men who had only received one dose of vaccine. One of these cases was due to *B. dysenteriae* Shiga and one to *B. dysenteriae* Flexner. As throughout the experimental work it has been impossible to demonstrate any protection against the disease after one dose of vaccine these two cases have been excluded from the returns under inoculated men.

At the same time they have not been added to the total number of cases among the uninoculated men, to which they probably should be added. The men returned as inoculated are only those who received two, or in some cases three, doses of vaccine.

During the same period of eighteen weeks there were sixty-six cases of bacillary dysentery among the uninoculated men of these three units. Of these fifty were diagnosed on clinical grounds and the infecting organism was recovered from sixteen.

The following table shows the number of cases among the inoculated and uninoculated men in the test units :—

TABLE I.

Unit	Uninoculated					Inoculated				
	Average strength	Bac.	Clin.	Total	Case incidence per cent	Average strength	Bac.	Clin.	Total	Case incidence per cent
A ..	406	4	27	31	7.6	285	1	6	7	2.4
B ..	437	2	14	16	3.4	386	—	1	1	0.2
C ..	630	10	9	19	3.0	292	1	—	1	0.4

Bac. = Cases in which the infecting organism was isolated.

Clin. = Cases diagnosed clinically, i.e., diarrhoea with blood and mucus in the stools.

Among the inoculated men there was no evidence of any negative phase as during the first fortnight after the inoculations were completed, and during which time the effects of wastage had not come into play, there were thirteen cases of dysentery among the uninoculated men (1,550) and only one case among the inoculated (1,150) and this was the man who developed the disease five days after his second dose.

At the same time it is interesting to note in view of the table of inoculation agglutinins that of the 9 cases of dysentery which occurred

among the inoculated 7 were contracted within four weeks of inoculation while after that time only 2 men contracted the disease over the remaining period of fourteen weeks that they were under observation.

The fact that a man has been inoculated does not seem to have any effect on the isolation of the infecting organism from his stools should he afterwards develop dysentery, as in the case of the inoculated men who subsequently developed dysentery the infecting organism was isolated from 22.2 per cent, and from the uninoculated men in 24.2 per cent of the cases.

The following table gives the results of inoculation in a base camp in France. The observations were carried out over a period of nine weeks. In this instance a nominal roll was made of the inoculated men and also of the control men who were present and uninoculated. There were 975 men inoculated and 1,361 men were taken as uninoculated controls and followed up through the nine weeks.

During that time there were four cases of dysentery among the inoculated men. Of these one was diagnosed by the isolation of the infecting organism and three on clinical grounds. Among the uninoculated there were 14 cases, of which 7 were diagnosed clinically and 7 by isolation of the bacillus causing the disease.

The case incidence among the inoculated per thousand per week for the period of the nine weeks was 0.46 and that for the uninoculated 1.13, giving a ratio of 1 to 2.45 in favour of the inoculated men. Here again the results obtained, though the figures are far too small to be of any great value, suggest that further trials might lead to even more encouraging results.

TABLE II.

Uninoculated					Inoculated				
Strength	Bac.	Clin.	Total	Case incidence per 1,000 per week	Strength	Bac.	Clin.	Total	Case incidence per 1,000 per week
1,361	7	7	14	1.13	975	1	3	4	0.46

Bac. = Cases diagnosed by isolation of the bacillus.

Clin. = Cases diagnosed clinically.

Table III shows the agglutination titres of the serum of inoculated men taken at intervals after inoculation; these figures refer to serum of men inoculated in the Near East and are estimated at intervals varying from seven days after the first dose, that is, on the day the second dose was given, to ten weeks after the second dose.

The inoculation titres correspond very closely to those observed by me in this country and published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS in June, 1917, with the exception of those with *B. dysenteriae* "Y" antigen. While the observed titres with this antigen were generally low and results very irregular in this table, I found that the serum of men

480 Results from the Use of Anti-Dysenteric Sero-Vaccine

inoculated in England gave a higher titre with this bacillus than with the other two types *B. dysenteriae* Shiga and *B. dysenteriae* Flexner. I am inclined to think that this inconsistency is due to the different antigens employed in the estimation of the agglutinin content of the serum and not to the lower content of the serum itself.

It will be noticed in the table that there is no demonstrable agglutinin in the serum after the first dose of vaccine when tested with *B. Shiga* antigen, and very little with *B. dysenteriae* Flexner and *B. dysenteriae* "Y" antigens. It is not until three weeks after the second dose that the agglutinins in the serum seem to reach their highest point, and as the titres taken at the end of ten weeks are as good if not better than those at the end of three weeks, the point of the curve is probably reached at some period between the two dates.

TABLE III.

		Nil	1:50	1:75	1:100	1:150	1:200	1:300	1:400	Number of men tested
Seven Days after First Dose.										
Shiga	..	100.0	..	..	..	..	..	..	..	6
Flexner	..	23.3	66.6	..	..	..	..	..	..
"Y"	..	83.3	16.6	..	..	..	..	..	..
Seven Days after Second Dose.										
Shiga	..	75.0	6.2	6.2	6.2	6.2	..	..	..	16
Flexner	..	..	25.0	18.7	50.0	6.2	..	..	..
"Y"	..	56.2	43.7	..	..	..	..	..	..
Three Weeks after Second Dose.										
Shiga	..	40.0	16.0	..	..	32.0	12.0	..	..	25
Flexner	..	20.0	..	28.0	..	32.0	20.0	..	..
"Y"	..	72.0	..	16.0	..	4.0	8.0	..	..
Ten Weeks after Second Dose.										
Shiga	..	27.7	33.3	16.0	5.5	11.1	6.3	..	..	36
Flexner	..	3.3	23.3	23.3	3.3	23.3	13.3	10.0	..	
"Y"	..	55.5	13.9	11.1	2.7	13.9	2.7	..	..
Seven Days after Third Dose of Vaccine.										
Shiga	..	14.3	42.9	..	42.9	..	..	..	..	7
Flexner	..	..	14.3	..	14.3	14.3	28.5	14.3	14.3	
"Y"	..	28.5	71.4	..	..	..	..	..	..

The figures represent percentages of the total numbers tested.

The groups do not represent the same batches of men, and the bottom group represents the sera of men who received three doses of the vaccine.

This apparently means that while there is no actual negative phase there is a marked latent period before the body responds to the stimulus of this vaccine to its full extent.

It is with regard to this fact that I mentioned that seven out of the nine cases of dysentery that occurred among the inoculated men in the Near East developed the disease within four weeks after inoculation while

only two cases occurred during the remaining fourteen weeks of the observed period.

At the end of twenty weeks all traces of inoculation agglutinins had disappeared from the blood in the majority of cases, though I have found agglutinin present in the serum of an inoculated man six months after his second dose. As a rule, however, after the end of four months they soon begin to be lost, lasting a somewhat similar time to the inoculation agglutinins after cholera vaccine has been injected into man.

Three doses of the vaccine seem to produce a higher agglutinin content than two, as one would expect to be the case. In practice it is generally impossible to give large bodies of men more than two doses of a vaccine.

From the agglutination table it will be seen that it is more difficult to produce agglutinins for the dysentery group of bacilli than for the other intestinal organisms. This I think may well be expected when one remembers how many cases of dysentery due to *B. dysenteriae* Shiga fail to agglutinate the specific organism with their serum except in very low dilutions.

Castellani [2] also mentions the low agglutination titre obtained after inoculation with a mixed dysentery vaccine consisting of emulsions of twenty-four hour agar cultures in normal saline. These titres are very low, but in his case he only gave 62·5 million bacilli of each type for the first and second doses as compared with 500 million of each type for the first dose and 1,000 million of each type for the second dose which was given in the present series of men inoculated with the sero-vaccine.

The following is a quotation from Castellani's paper:—

"The reaction is not very severe though more marked as a general rule than after the typhoid-paratyphoid vaccine. Agglutinins generally develop for all the germs of the dysentery group which have been injected, but their amount is not high, the agglutination limit seldom being higher than 1 in 40, and is somewhat inconstant and irregular; but the same may be said of individuals inoculated with simple mono-vaccines Shiga-Kruse, Flexner, etc."

This irregularity is also seen in the case of dysentery convalescents. In a series of agglutination tests carried out by Ledingham and Penfold [3] on the sera of 103 convalescents, the majority of whom gave a history of dysentery, we find a varying agglutination content ranging from no agglutination in a dilution of 1 in 50 to one in a dilution of 1 in 800 when tested with *B. dysenteriae* Shiga antigen. In this series the time after the onset of the disease is not stated but it is probably some weeks or a month or two.

Kennedy and Rosewarne give the agglutination titres of five of their cases [4]. These were all instances of carriers of either *B. dysenteriae* Shiga or *B. dysenteriae* "Y." Of the Shiga cases only one gave a positive reaction and the titre in this case was only complete in 1 in 15 and partial in 1 in 40; the tests being carried out seven months after the onset

482 *Results from the Use of Anti-Dysenteric Sero-Vaccine*

of the disease. The two "Y" cases tested about four months after the onset of the disease gave complete positive results, one in a dilution of 1 in 500 and one in a dilution of 1 in 80.

All this may be regarded as an indication that it is a more difficult problem to confer immunity against this group of diseases than against diseases of the enteric group, since I have constantly found that unless there was some agglutinin present in the animal's or man's blood there was very little other evidence, direct or indirect, of protection.

The following instances all show this point:—

In my original paper [1] rabbit No. 17 in Table II was the only rabbit of the series whose serum failed to show any agglutination at the time the test dose of *B. dysenteriae* Shiga was given. This rabbit was also the only one that did not show protection against the dose, with the exception of rabbit No. 21 which was not considered to have died from the effects of the injection.

Again, in the case of H. G. (Part II of the paper), when inoculated with vaccine mixed with unabsorbed serum, his serum showed neither the presence of agglutinins nor bactericidins, and failed to protect a rabbit against $2\frac{1}{2}$ M.L.Ds. of Shiga toxin. When, after the lapse of four months, this individual was inoculated again with the vaccine mixed with absorbed serum not only did his serum agglutinate *B. dysenteriae* Shiga in a dilution of 1 in 150, but 0.5 cubic centimetre of his serum protected a rabbit against 5 M.L.Ds. of toxin (Part IV of the paper).

Also in this paper I mentioned that the man who developed dysentery due to *B. dysenteriae* Shiga infection after he had been inoculated, failed to show the presence of any inoculation agglutinins in his blood at the time he contracted the disease.

The constant recurrence of this fact is interesting, and as far as it goes seems to indicate that the presence of agglutinins in the serum of inoculated individuals is an essential addit to a lasting immunity.

The following experiment, originally undertaken with a view of estimating the difference between the formation of opsonins and the immune body, as shown by the presence of the complement fixing proportion of the serum of men inoculated with the vaccine when mixed with absorbed and unabsorbed serum, also demonstrates in the case of opsonin formation the slow rise of the opsonin curve as compared with that seen in the case of other antigens.

Three men were inoculated with dysentery vaccine mixed with anti-dysenteric serum. In each case the dose of vaccine consisted of 500 million *B. dysenteriae* Shiga, 500 million *B. dysenteriae* Flexner, and 500 million *B. dysenteriae* "Y" mixed with 0.8 cubic centimetre of the serum. In the case of (A) the serum had been absorbed with the homologous strains of the organisms used in the vaccine and in the cases of (B) and (C) it had not been treated in any way. The second dose was given one week after the first and consisted of double the first, both as regards the amount of vaccine and

serum given. In the case of (A) the general reaction after the first dose was indicated by malaise and headache, which made their appearance on the same evening as the inoculation took place. This had disappeared by the following morning. The local reaction was manifested by a reddening, slight swelling, and tenderness round the site of inoculation. This lasted about forty-eight hours. After the second dose there was no general reaction and very little local. In the cases of (B) and (C) the reaction was practically the same as in the case of (A), being perhaps slightly milder.

Two estimations of the opsonizing power of these men's serums were done. The first estimation was carried out on the fifteenth day after the second dose of vaccine, the second on the twenty-first day after. The serum on each occasion was first heated for twenty minutes at 55° C. to destroy the thermolabile or normal opsonins. The serum used as a normal control was also treated in the same way. The estimations were carried out by using a final dilution of serum of 1 in 12, and leaving the mixture of heated serum, washed cells, and emulsion of organisms in a water bath for fifteen minutes. The following table gives the results of the two estimations :—

TABLE IV.—ESTIMATION OF THE OPSONIC INDICES.

			Opsonic index		Opsonic index	
			15th day		21st day	
A	{	Shiga	3.1	..	..	4.0
		Flexner	3.5	..	..	14.3
		"Y"	2.0	..	..	12.6
B	{	Shiga	1.8	..	..	1.25
		Flexner	2.8	..	..	3.0
		"Y"	1.3	..	..	6.0
C	{	Shiga	1.6	..	..	2.75
		Flexner	2.5	..	..	2.5
		"Y"	1.8	..	..	6.3

The bacterial contents of 100 cells were counted in each case. In the first estimation, that done on the fifteenth day, the cells when mixed with the serum of the inoculated men gave the following average number of bacilli phagocytosed per cell.

		Shiga			Flexner			"Y"
A	..	2.6	..	..	1.0	..	..	1.2
B	..	1.5	..	..	0.8	..	..	0.8
C	..	1.4	..	..	0.7	..	..	1.1
Control	..	0.8	..	..	0.3	..	..	0.6

On the second occasion the normal serum gave a count of 0.5 bacilli per cell with *B. dysenteriae* Shiga, 0.3 with *B. dysenteriae* Flexner, and 0.7 with *B. dysenteriae* "Y." In this experiment not only is the superiority in opsonizing power of A's serum over the other two brought out, but it also shows the slow response of the body to the vaccine.

Complement Fixation.—This experiment is included as it demonstrates again the larger amount of immune body present in A's serum compared

484 *Results from the Use of Anti-Dysenteric Sero-Vaccine*

with that present in the serum of B and C. The estimation was carried out on the fourteenth day after the second dose of vaccine had been received, and unfortunately the experiment could not be repeated later, so that no comparison between the amount of immune body present on the fourteenth day after inoculation and the amount present at a later date could be made.

The antigen used consisted of a twenty-four hour growth on agar of the three organisms used. One loopful (two milligrams) of the culture from the surface of the agar slopes was suspended in two cubic centimetres of normal saline. The serum to be tested was heated for twenty minutes at 55° C.

The following control experiments were carried out:—

(1) It was found that the antigen when diluted to 1 in 5 just did not cause mechanical deviation, so that a dilution of 1 in 10 was used for the actual test.

(2) The serum to be tested when diluted to 1 in 10, in the absence of antigen, bound 1 M.H.D. of complement, but not 1·5 M.H.Ds.

The actual test was then carried out with the results shown in the table. The final dilution of the serum was 1 in 40.

TABLE V.—COMPLEMENT FIXATION.

Serum			Antigen		Number of M. H. Ds. of complement found	
A	{	Shiga	..	4.0
				Flexner	..	3.0
				" Y "	..	2.0
B	{	Shiga	..	2.0
				Flexner	..	1.5
				" Y "	..	1.5
C	{	Shiga	..	2.0
				Flexner	..	1.5
				" Y "	..	1.5
Control	{	Shiga	..	1.5
				Flexner	..	1.5
				" Y "	..	1.5

CONCLUSIONS.

(1) That inoculation against bacillary dysentery with this vaccine can safely be carried out, and from the results obtained, as far as they go, there seems to be some hope of reducing the case incidence of this disease in epidemic and endemic areas.

(2) That the use of this vaccine produces no negative phase, but that it is more difficult to raise the immunity of all individuals with dysentery vaccine than it is with vaccines against other organisms of the intestinal group. Also a period of about twenty-one days is required after the second dose of vaccine before the inoculated man fully responds to the vaccine in the way of producing immune substance. Where practicable, three doses of the vaccine, the third being the same size as the second, should be given for choice.

(3) That the length of time that the resulting immunity lasts has not been fully established, but that it is probably from four to six months, and may be reckoned analogous to that produced by inoculation against cholera.

(4) That in view of the above paragraphs wholesale prophylactic inoculation against bacillary dysentery is not advocated by the author, but it would seem reasonable to suggest inoculation at the beginning of the summer months among units and formations in which dysentery has been endemic, and among those in which there may possibly be carriers of the disease. The inoculation of troops among whom there has arisen a sudden outbreak of the disease would also appear safe, and in conjunction with other preventive measures might assist materially, I think, in its control.

The work contained in this paper has been accomplished in the main by workers and observers other than myself, the results of which have been merely collated and tabulated by me.

For access to these figures and results I am indebted to the courtesy of the Authorities at War Office and Colonel Sir William Leishman, C.B., F.R.S.

REFERENCES.

- [1] GIBSON. *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, June, 1917, p. 615.
 - [2] CASTELLANI. *Brit. Med. Journ.*, February 26, 1916, p. 306.
 - [3] LEDINGHAM and PENFOLD. *Brit. Med. Journ.*, January 8, 1916, p. 47.
 - [4] KENNEDY and ROSEWARNE. *Brit. Med. Journ.*, December 23, 1916, p. 864.
-

THE TECHNIQUE OF AMPUTATIONS, PARTICULARLY THE TREATMENT OF NERVES.

By EDRED M. CORNER, M.C.CANTAB., F.R.C.S.

Surgeon to the King George Hospital, the 5th London General Hospital, Queen Mary's Auxiliary Hospital, Roehampton, the John Ellerman Hospital, the Oakenshaw and other Red Cross Hospitals, St. Thomas's Hospital and the Children's Hospital, Great Ormond Street, etc.

IN this War there is hardly a more frequently performed operation since the introduction of the Carrel-Dakin method, which seems to have banished most other major operations in the earlier phases of wound treatment, than an amputation. In consequence there have been many opportunities for the study of their results and the fact has been brought to light that the results of amputation could and should be very much improved. It is natural, and tends to improvement, that the technique of so frequently performed an operation should be criticized. The very frequency of the operation shows that this criticism must have widespread results. Amputations must no longer be some of the worst and most slovenly done operations. It must no longer be thought that the technique of amputations has reached finality and that the operation can be handed over to junior officers.

In civil life there is little or no opportunity for most of us, of knowing about the conditions of an amputation stump, its treatment and the incidents which may happen to it. At St. Thomas's Hospital in 1913, the year before the War, only thirty-four amputations of limbs were performed amongst 5,483 operations on patients admitted to the hospital. This is approximately one amputation in 161 major operations. Moreover, the great majority of these amputations were done by house surgeons and other young officers, particularly for sepsis and gangrene in the surgical beds of the infectious block attached to the hospital. Thus the cases escaped skilled, extended and critical observation and, not until this War, was erudite attention given to amputation stumps, such as is now done at the Queen Mary's Hospital, Roehampton, and daughter institutions, where it is found that a large number of the amputation stumps there certified ready to be fitted by apparently competent authorities are unfit for wearing limbs principally because of their tenderness. Others have sinuses which are unhealed and many have tender nerve bulbs. Yet such stumps are said to be ready for fitting an artificial limb! Truly knowledge of the study of amputation stumps is not widely diffused.

In performing an amputation the first structure to be dealt with technically is the skin in which flaps are cut, except in the guillotine operation, which is solely and amply justified in saving life. It is often used for laziness and then has no excuse for it. Whenever there is any

doubt it is better to make flaps and sew them back—one stitch for each usually suffices—to the skin of the limb, leaving the wound quite open for a few days, after which the flap is released. The very great majority of such amputations are done above the sepsis or nearly above the sepsis, and can be sterilized in a few days' time by the Carrel-Dakin method of wound treatment. The skin, connective tissue and muscles are dealt with adequately by flap cutting. In their turn vessels are treated satisfactorily by ligature, but to cut and to leave open nerves, muscles, connective tissue and bone exposed in a wound which is to be primarily or secondarily the seat of sepsis is wholly unsatisfactory, to say the least of it. A superlative stage of this inflammatory nerve irritation is occasionally seen in the chronic twitching of muscles which gradually spreads up the limb and progressively affects more and more of the trunk muscles, evidence of an ascending irritation, perhaps of an ascending neuritis. For a long time it was thought that the fact that a nerve was bulbous was sufficient to demand its excision. Slowly but surely it was found that though all cut

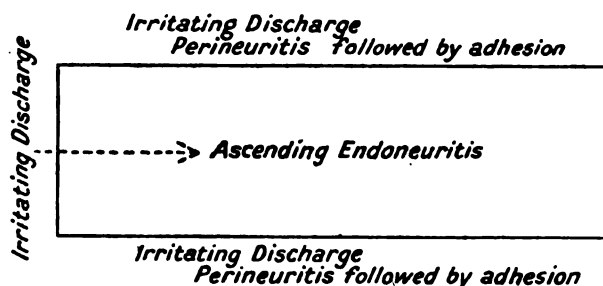


FIG. 1.—Diagram illustrating the inflammation around and the ascending inflammation within a nerve the end of which is exposed in an inflamed wound.

nerves were bulbous only a few were painful and needed removal. Then the idea grew that if a cut and healing nerve end was surrounded by inflammation, a kind of perineuritis, the nerve became adherent to the structures around it and was very apt to become painful. Very great difficulty was found in dissecting out such adherent nerves.

The formation of adhesions about nerve ends was an adequate reason for cutting the nerves short in the concluding stages of the amputation. If the nerve is pulled down strongly before being cut, it will retract, and the shorter a nerve is cut the further its open end is removed from irritation. Although sepsis travels up the connective tissue planes, particularly of vessels and nerves, the swollen and repairing cut ends of the muscles might prevent irritating fluids from reaching the cut nerve before its end was sealed by repair.

Such perineuritic inflammatory tissue was found to be formed in consequence of injecting the nerves, as with alcohol. Some of the injection escaped from the punctured sheath into the surrounding connective tissue

and led to its inflammation, the adherence of the nerve, and the consequences from the contraction of that scar tissue.

Clinically it was sometimes found that though there was benefit from excising the painful nerve ends, sometimes *the tenderness of the stump returned*. Operating on such a stump in the King George Hospital I found that some nerve fibres had grown from the imperfectly closed end of the short cut sciatic nerve, found their way along the connective tissue planes, as along a scaffolding, and had formed a new and sensitive nerve ending in the scar tissue of the stump. This was the case of Private T. C., 4196, Black Watch, transferred from the Queen Mary's Auxiliary Hospital, Roehampton, to my service at the King George Hospital. The stump was healed but very tender, especially along the sciatic nerve. The scar was excised together with a neuroma on the obturator nerve. The sciatic nerve was then exposed and excised.

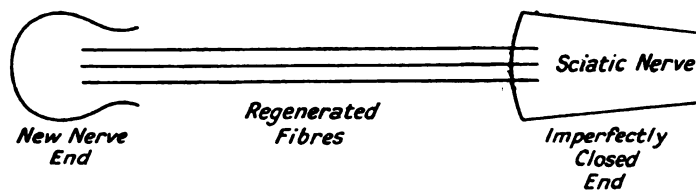


FIG. 2.—Diagram of the growth of nerve fibres from the imperfectly closed nerve end in an amputation stump, explaining the formation of a new and tender nerve ending, and emphasizing the desirability of closing the nerve.

Here was direct evidence that the fault lay in leaving the cut nerve end "open" and that tenderness of the stump, from regeneration of nerve fibres, may return if the cut nerve end is left open, even in the absence of all irritation.

Another type of the imperfect closure by sealing of the end of a nerve left open in an amputation wound was found in the course of my operations at the King George Hospital.¹ Where the adhesions were thickest around a nerve bulb it was often found that nerve tendrils existed extending from the bulb to neighbouring tissues. They varied in size and ended in nerve bulbs in the scar of the skin, for adhesion of the nerve bulb to which they were much responsible, or the muscles. The existence of such tendrils sprouting from the nerve bulb offers a possible explanation for the varying distribution and diffuseness of the pain clinically resulting "tender nerve bulbs," and also for the care with which the nerve ending must be treated and closed at the time of the amputation. In time almost all of the open nerve end is sealed, but from one, two, or more places a stray fibre, or stray fibres, regenerate and grow along the course of least resistance and are responsible for recurrent tenderness and pain in the stump, and,

¹ Pensioner, A. T. H., 9344, in A4.

probably, for some return of function. Such regenerations may take place in the absence of all sepsis. It is unusual to find more than two tendrils to each bulb, one is the usual number. The existence of tendrils is an argument in favour of removing all tender nerve bulbs.

A nerve end, left open in a healing suppurating amputation wound, often bathed in irritating fluids, no matter how short it is cut, receives a certain amount of irritation; some of which is conducted to the interior of the nerve and sets up what may be called an endoneuritis, some to the exterior of the nerve where it sets up a perineuritis and leads to the formation of adhesions as in the cases just considered. In certain instances this irritation ascends the nerve and may be cured by the timely excision of the nerve nearer to the trunk. If it goes on, the irritation ascends

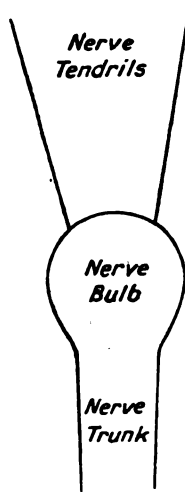


FIG. 3.—Diagram of regenerated nerve tendrils extending from end bulb of nerve to the neighbouring tissues, causes of irregular and diffuse pains in amputation stumps.

higher in the nerve and it may be necessary even to divide nerve roots after performing a laminectomy. Occasionally it reaches the cells of the anterior horn of the spinal cord and perhaps it may ascend higher. Clinically it would appear that the higher the nerve irritation goes the more is it preceded and surrounded, like a penumbra by a wave of functional disturbance which allows the condition to be recognized and cured before the irritation gets too high. In bad cases the irritation may have proceeded beyond the reach of surgery. The accompanying "functional" elements in the disease may be alleviated by rest and medical treatment and in time the nerve irritation may die out and the patient recover. The treatment of these patients is twofold, surgical and medical; and both should be carried out contemporaneously.

On the two grounds of the irritation, outside and inside the divided and open nerve, it is urged that attempts should always be made to deal with

divided nerves as is done in the skin by flap-cutting, or in the areolar tissue and in the muscle dividing, and in the ligation for the divided vessels. The intelligent procedure is to close the open nerve, as by a ligature after proximal and several crushings of the nerve with artery forceps. As the divided end of the nerve will be sealed in a few hours, the ligature should only be of the finest and most quickly absorbed catgut.

The end of the nerve, capped by sterile crushed nerve tissue, is then covered, sealed and held in place by the ligatured nerve sheath. As the crushing of a nerve trunk might cause a stimulus to reach the spinal cord of the unconscious patient, and cause a large fall of blood-pressure, it is desirable to block all large nerve trunks with a novocain injection before crushing them. Or nerve flaps may be cut so as to close the open end. The latter proceeding demands a nerve end large enough for the manipulation, e.g., the sciatic, whilst the former method, ligature and proximal crushing, is applicable to any nerve large enough to be visible to the naked eye.

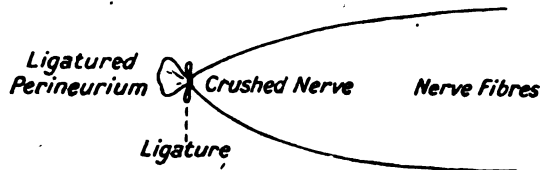


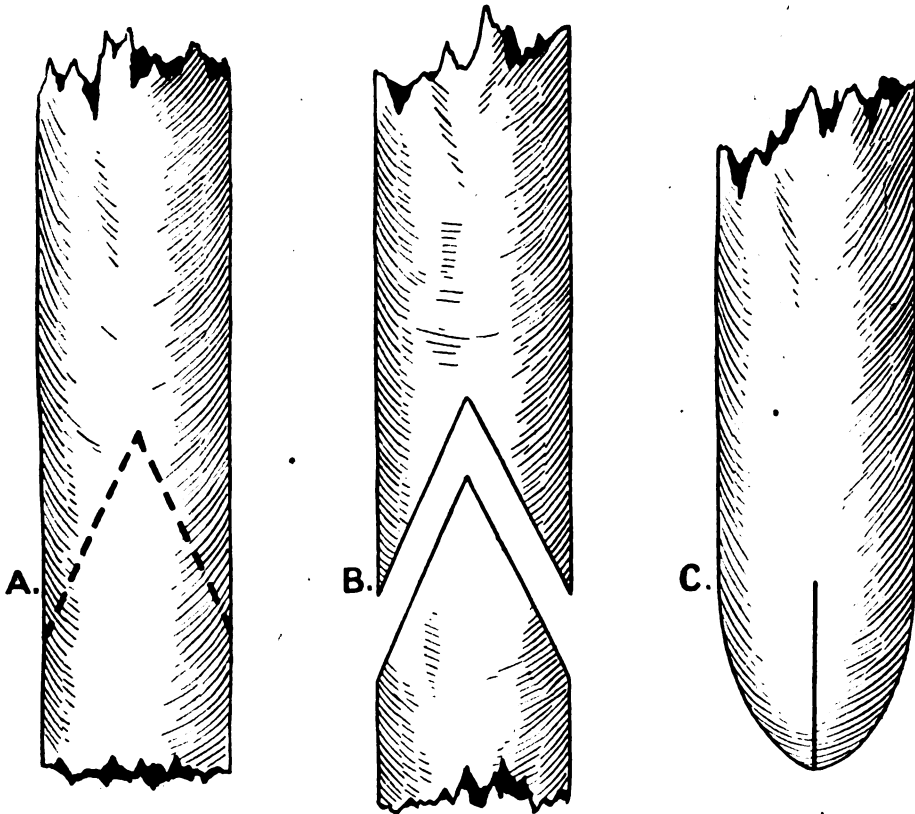
FIG. 4.—Diagram illustrating the closure of a nerve by ligature of its well-crushed end.

There is always an unhappy feeling that from time to time, and in spite of all care, a nerve filament may have escaped crushing and dividing. When ligatured with an unabsorbable material like silk, it would be very painful, so that when the nerve is large the most practical thing to do is to pull it down, *divide it by two cuts*, making rather long flaps, one from each side, so that the cut nerve end becomes closed as in fig. 5, by the pressure of the surrounding structures, as it retracts. This proceeding is shorter and simpler than any flap cutting. Smaller nerves should be pulled down so strongly before they are divided that they may even be avulsed. Avulsion of a large nerve may cause injury in the spinal cord. It is better to divide these nerves, with two opposing cuts making them as short as possible so that their cut ends lie far from the irritation of the septic and healing wound. In a few hours their open ends will be sealed by a membrane of fibrin whilst they are protected from the fluids in the wound, by the bulging and pressure of the surrounding tissues.

These two ways of dealing with large and small nerves are the most practical means of dealing with the nerves in an amputation. No nerve ends should ever be left lying open in a healing wound, amputation or otherwise. It has never been found that flaps of perineurium are to be relied upon to close the nerve. Their making prolongs the operation and is no obvious gain.

This faulty treatment of divided nerves is the principal cause of the lasting tenderness of many a painful stump.

Then, do we treat the divided bone properly? I do not think so. Attempts have been made to close the end of the divided bone with periosteum and osteoplastic flaps. These never have succeeded. The



The dotted line shows the direction of the incisions.

FIG. 5.
The incisions.

Retraction after the incision producing a falling together of the flaps which are pressed together by surrounding tissues.

great majority of sinuses in amputation stumps lead to necrosed bone, primarily necrosed by the thrombosis of vessels brought about by the heat generated with the saw cuts¹ and secondarily infected. The saw is a useful instrument in amputation, but there could be better technique.

¹ Messrs. Allen and Hanburys are constructing a saw for the author minimizing the amount of heat so generated.

There would not be nearly so many stump sinuses if its use were discarded for a guillotine.

The open bone in an amputation stump is similarly situated as regards the sources and effects of irritation as is an open nerve; corresponding to the perineuritis and the endoneuritis are periostitis and osteomyelitis (see fig. 1).

Much divided muscle is left "open" in the amputation wound and is therefore exposed to all the accidents which we know affected a similarly placed nerve or bone, peri- and endo-myositis, such as is the cause of temporary and diffuse tenderness of a stump shortly after operation. Cut muscles could be sealed with a continuous catgut suture. It is remarkable how such closing lessens the amount of the fluid exuded and discharged from the wound. This examination of procedure would ensure the identification of all the divided structures. Most surgeons have at one time or another failed whilst doing an amputation to find even so large a structure as the sciatic nerve on account of its retraction. The identification and separate treatment of the various structures in an amputation stump would alike benefit both surgeon and patient and should be done if the anæsthetist permits.

To sum up, the technique of amputations should be revised in many particulars. The treatment of the divided skin, connective tissue and muscles appears satisfactory. The treatment of divided nerves is not satisfactory and I would suggest flap cutting for large nerves and crushing the nerve proximal to the point of division with ligature (quickly absorbable) of the divided and crushed ends for small nerves. The method of dividing the bone is not satisfactory. Divided muscles should be closed so that inflammation may not ascend in them. In fact, the skin of no amputation wound should be sutured until all open structures, except perhaps bone, have been sealed. In the clinical importance of their closing, these may be placed in order: vessels (an immediate danger from hæmorrhage), nerves and bone (causes of remote disabilities and necessitating further operations for tender ends, necrosed fragments, etc.); the other structures like muscles seal themselves in time. A few well-placed stitches shorten the time of convalescence greatly.

X-RAY WORK IN A BASE HOSPITAL IN FRANCE: A FEW OBSERVATIONS OF A PRACTICAL NATURE.

BY CAPTAIN B. H. STANLEY AYLWARD.

Royal Army Medical Corps.

WAR X-ray work, except possibly in hospitals in England, differs essentially from peace-time work. Treatment need not be considered, except perhaps as an amusement for the radiologist when he finds himself, as he sometimes does, with very little to do.

The important thing for the radiologist to grip on to on being sent abroad is that rapidity in his work is the first thing required of him. The more cases he can handle in a given time, the more use he will be to his unit. He will soon find that the more efficient he becomes, the more work he will be asked to do, until in a rush he will get in one day more than he can possibly do in three; then it is that he realizes the importance of seconds saved in each case. Let him work as hard as he may, cases, on which X-ray reports have been asked for, will be evacuated before he can get them done. Rapidity in handling cases therefore is of the utmost importance.

To have a practical experience of War surgery is a great assistance to the War radiologist, as it enables him to know what the surgeon requires, and so he avoids wasting his own time on unnecessary work, and often saves the operator much trouble and annoyance. He must endeavour therefore to combine speed with accuracy, and to serve up to the surgeon the information he requires in as practicable a form as possible. As regards outfit he will probably have to take what is given him, although any reasonable indent is passed if the article can be obtained. The man who cannot work without a whole lot of special apparatus is usually not much use, even when his demands have been satisfied. The more simple the outfit the better, complication usually means time wasted in handling the cases. But, whatever the outfit be, it must be kept tuned up to the very highest pitch; if anything shows signs of getting out of order, it must be put right at once; there may be a rush of work the next day, and the machine will probably break down.

The table must be so arranged that the patient has not to be moved off the stretcher. This can easily be done by removing the top, and fixing a cross-piece of wood at either end, on which the handles of the stretcher rest. All the work can be done quite satisfactorily on a stretcher, and no time is wasted in lifting the patient on and off the table, an undertaking which is often troublesome to the radiologist, and painful to the patient.

A tube-box underneath the table, which can be easily and quickly moved, preferably with the foot, is necessary, as every case must be thoroughly screened, otherwise many foreign bodies will be missed. In a

limb it is advisable always to screen at least to the joint above and below. In the trunk it depends upon the case, but often it will be necessary to screen the whole chest, abdomen and pelvis: at all times it is better to err on the safe side. The overhead tube box is very rarely required, and unless it is part of the table is most unsatisfactory, as the floors of most hut hospitals are very lightly constructed, and anyone moving in the same hut causes the overhead tube to oscillate considerably.

Some form of apparatus for taking lateral heads is advisable: Major Higham Cooper's is quite satisfactory, and is easily used on a stretcher; antero-posterior heads can also be taken in it by removing the rubber cushion and using the underneath tube; the woodwork appears to stop very few rays. In the majority of cases it is quite unnecessary to take plates, and it will be found that most surgeons prefer accurate markings to plates in all ordinary straightforward cases. Plates of a foreign body lying in the muscle of the thigh are of little use to the surgeon, but if the foreign body is marked in the manner to be described, the surgeon at once realizes where it is.

A foreign body should therefore if possible be marked on the skin; plates may be taken as well if desired, but the surgeon will probably be guided by the marks. The only exceptions to this rule are joints and head and neck cases, or where it is wished to show a fracture. Marks round joints and on the neck are apt to be misleading, as the slightest alteration in position upsets even the most careful marking. Plates have not this disadvantage to the same extent; two must always be taken, an antero-posterior and a lateral whenever possible.

Three colours are required for marking, say green, red and blue; green is used for antero-posterior, red for lateral, and blue for the nearest point on the skin when the foreign body is superficial. Ordinary microscopic stains do very well and should be kept in a small bottle with an india-rubber cork, the cork being used for making the mark.

The tube must be carefully centred so that the central ray passes vertically upwards through the exact centre of the diaphragm. A metal marker with a small ring at one end, of a suitable size to take the india-rubber cork of the stain bottle is required; it is an advantage to have the handle of the marker made out of a piece of brass tubing, as when the cut end of the tube is pressed up against the skin, it leaves a small ring depression which is easily distinguished and upon which the mark is placed.

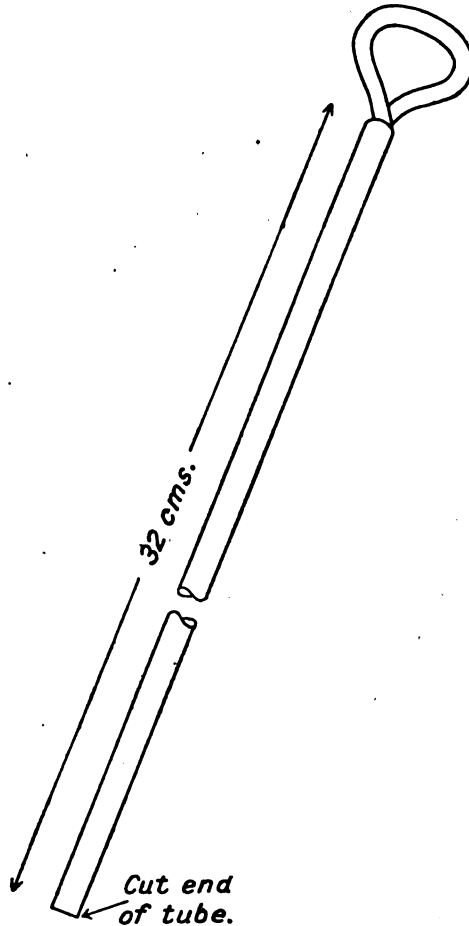
The patient is lying on the stretcher, which is on the framework of the table; he must be placed absolutely flat on his back or abdomen according to circumstances, with the inner borders of his feet pointing directly upwards. In a very few cases it will be found that the patient cannot be got into this position, he must then be placed in some convenient position that can be described accurately, so that the surgeon may be able to place him in the same position again on the operating table, otherwise the

marking will probably only be misleading. He is screened and a foreign body found.

It is usually best to make the lateral mark first, as the second antero-posterior mark often involves moving the patient. The blunt end of the marker is placed up against the skin laterally opposite the foreign body at more or less the supposed depth. The tube is now moved longitudinally and the movement of the foreign body and the end of the marker compared; if the marker moves most it is too far from the screen and must be tried closer. Finally a position is found where the end of the marker and the foreign body move together when the tube is moved. The light is then turned on and the place marked in red. The diaphragm is now closed and the tube moved until the foreign body is in the centre of the circle of rays; the ring of the marker is then placed over the foreign body, the light turned on and a green mark made by pressing the cork of the stain bottle on the skin through the ring. Finally a second antero-posterior mark is made in exactly the same way, but with the marker underneath the patient, it is usually necessary to turn the patient or lift the limb in order to make this mark on the skin. If the first antero-posterior and the lateral marks come fairly close together it is not really necessary to make the second antero-posterior mark, as it will be so far away from the foreign body as to be practically useless to the surgeon. Sometimes in limbs it is advisable to make two lateral marks, one on each side of the limb. A little practice is required in judging the difference of movement of the foreign body and the end of the marker, but once this is acquired the method is very quick and very accurate. It is advisable to open the diaphragm pretty wide and take a good long sweep with the tube, as of course the greater the movement of the tube, the more accurately the depth of the foreign body is gauged. There are several instruments designed for getting the depth of the foreign body by screening, but they all take much longer to use, and to tell the surgeon that the foreign body is so many centimetres deep to the mark on the skin does not convey as much information to him as a lateral mark accurately placed.

The method of turning the patient so as to make the lateral mark in the same way as the antero-posterior marks certainly takes more time than the method described above, and the results are often inaccurate, as it is very difficult to say when the patient has been turned exactly through a right angle. If the foreign body is superficial, that is, not more than one centimetre deep, one mark on the skin is sufficient; it is easier in this case to rotate the patient or limb until the position is found where the foreign body appears nearest to the skin, the blunt end of the marker is then placed on the skin and the spot is found from which the foreign body is most easily moved. The tube is then moved and the movement of the foreign body and the end of the marker judged as an extra safeguard. The place is marked in blue. If the surgeon makes an incision through the mark towards the centre of the limb or trunk he will strike the foreign body.

The practice acquired in judging whether the point of the marker is above or below the depth of the foreign body is very useful in the removal of foreign bodies under the rays, and it enables the radiologist to assist the surgeon by removing any foreign bodies which cannot be got by the usual operation on account of their small size or the position they lie in. It is a good plan to explain the system of marking to each of the surgeons, and



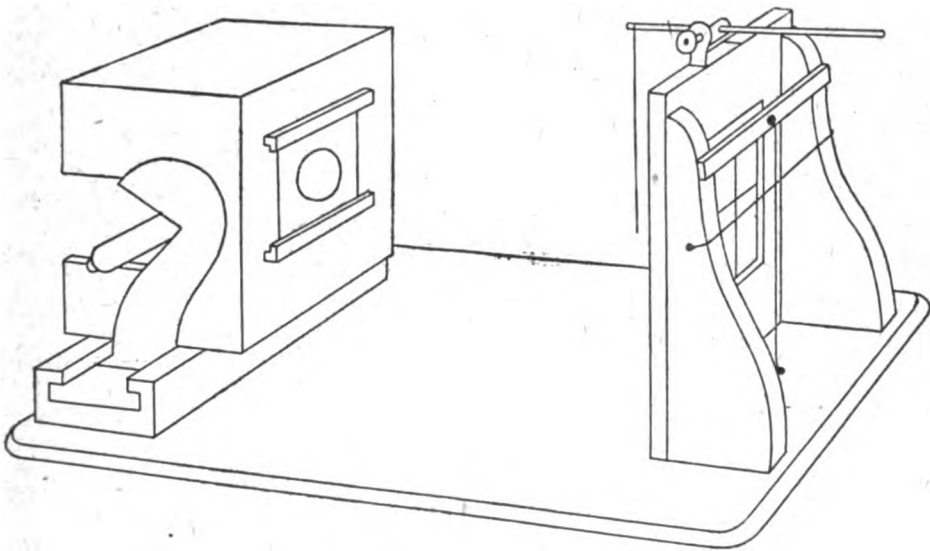
Sketch of marker.

to put up in the operating theatre a notice explaining exactly what the different coloured marks mean. It also helps the surgeon if a rough drawing of the size of the foreign body is sent in on the report.

The arm will be found to be a difficulty often, as sometimes the foreign body is in an awkward place to get at, and in many cases the patient cannot place the limb in the position required, the only thing then is to take some convenient position and describe it carefully on the report.

Foreign bodies lying deeply in the trunk are best marked either on the back or front in the antero-posterior position, and the depth then worked out either by stereoscopic plates, if there is a likelihood of bone injury, or by the two photographs on one plate method, which gives the depth accurately and is quicker than the stereoscopic, or one of the methods of getting the depth by screening may be used if preferred.

In head cases antero-posterior and lateral plates are usually sufficient, but it is often very difficult to say from them whether the foreign body is inside the skull or not. If there is any doubt, or if a more exact localization is required, then two small plates must be taken, the first being a plan plate with the tube in the central position, the second with the tube movement of six centimetres, the estimated nearest point on the scalp being placed in contact with the cross wires. If the cross wires are marked on the skin it is very easy afterwards to mark the actual nearest point and give the depth, by using the same method as described below for eye work.



Eye apparatus.

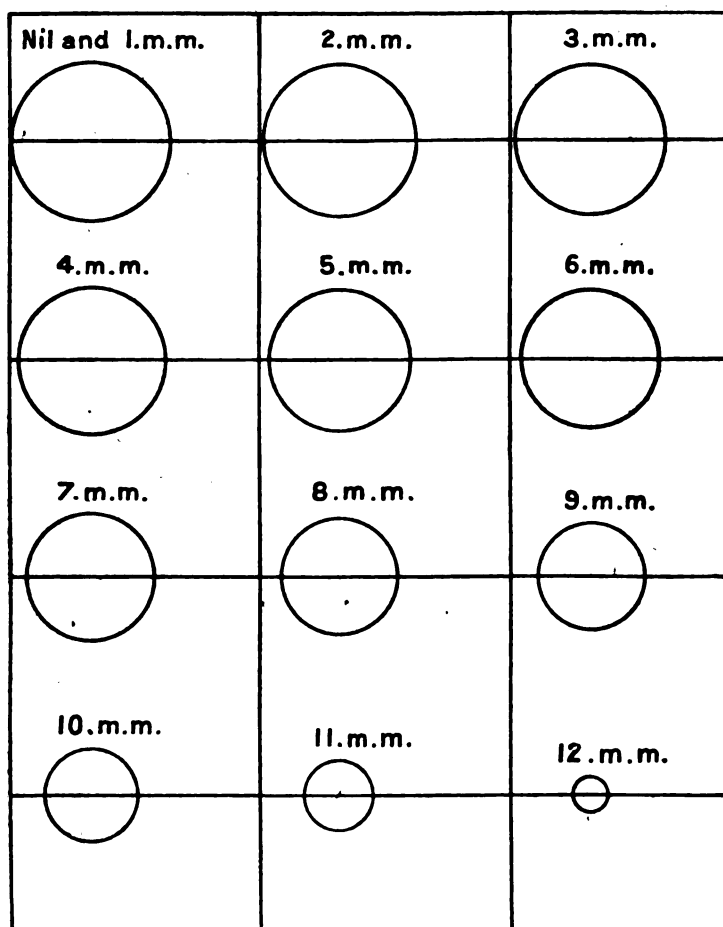
Eye localization is a special branch of the work which the radiologist abroad may be called upon to do, and probably he will have no special apparatus. A simple form of apparatus which gives very accurate results can be made with the help of the hospital carpenter and a little ingenuity. The apparatus in use in this hospital was evolved from the idea of Major Higham Cooper's head apparatus, and was made in the hospital. It consists in a base board forty by seventy-five centimetres, on one end of which is fixed a tube box movable in a transverse direction six centimetres each side of the central position. Fifty centimetres from the anticathode

is fixed transversely at the other end of the board a solid upright frame holding an old full plate with two cross wires stretched across it, the horizontal wire being twenty centimetres above the base board. About five centimetres behind the glass plate are stretched two more cross wires corresponding to the two on the glass plate. On the top of the upright frame holding the glass plate is fixed a metal pointer with a universal joint so arranged that the point can be fixed in contact with the skin, just above or below the patient's eye when he lies in the apparatus. The tube with the tube box in the central position is centred accurately on the two sets of cross wires so that when the anticathode is sighted from the other end of the apparatus through the glass, first come the nearest cross wires, then the cross wires on the glass, and these coincide accurately with the centre of the anticathode at the other end of the apparatus. The patient lies on his back on the table or stretcher with the side of his face to be photographed up against the glass plate, an arrangement of canvas straps is used to fix the head firmly, once he is in position. Under his head is placed the india-rubber cushion of Major Higham Cooper's head apparatus, which is blown up or deflated to raise or lower the head as required. Longitudinal movement is obtained by moving the whole apparatus on the table or stretcher. The patient's head is now arranged so that the centre of the front of his cornea coincides with both sets of cross wires when sighted in the same way as when the tube was centred, and it is fixed in that position. The metal pointer is lowered until it touches the skin either just above or just below the patient's eye, and moved laterally until it lies in the same antero-posterior vertical plane as the centre of the cornea, when it is locked in position. A plate is placed up against the back of the glass plate. The central ray now passes through the centre of the front of the cornea on to the plate at the point where the cross wires intersect. From this plate we can say how far above or below the central corneal axis and how far in from the plane tangential to the centre of the anterior surface of the cornea a foreign body lies, simply by measuring the distance on the plate of the foreign body from the wires (a small correction must be made for the divergence of the rays if absolute accuracy is required). The tube box is now moved six centimetres, usually away from the patient's shoulder, and a second plate taken. By measuring the movement of the pointer and of the foreign body on the two plates, it is easy to calculate how much nasal or temporal the foreign body lies.

A simple method of finding out whether the foreign body is in the globe is to have a series of circles drawn on a piece of transparent paper corresponding to vertical antero-posterior sections of the globe at millimetre distances from the central vertical antero-posterior plane (for practical purposes the globe may be taken as a sphere having a diameter of twenty-five millimetres). The position of the cross wires must be marked in for each circle. The plan plate is placed on the corresponding circle (so many millimetres nasal or temporal) with the cross wires coin-

ciding with the cross wires on the paper. If the foreign body comes inside the circle it is inside the globe.

The details of constructing the apparatus have been left to the individual ingenuity, as so much depends on the material and workmanship available.



Sizes of vertical antero-posterior sections of globe at millimetre distances from central vertical and posterior plane.

This article does not pretend to any originality, but it is an endeavour to explain the method used after a year's experience of X-ray work in a Base Hospital in France, in the hope that some of the ideas may be of use to the radiologist who is sent abroad. Acknowledgments are due to Captain B. T. Lang, R.A.M.C., for the idea of the pointer fixed on the eye apparatus, which is a great improvement on the old method of sticking a piece of fuse wire on the lower lid with plaster, and to Captain G. T. Loughborough, R.A.M.C., for the method of finding whether the foreign body is in the globe.

PRELIMINARY AGGLUTINATION IN THE ISOLATION OF TYPHOID AND DYSENTERY BACILLI FROM THE EXCRETA.

BY CAPTAIN WILLIAM FLETCHER.

Royal Army Medical Corps.

*Pathologist, Institute for Medical Research, Kuala Lumpur,
Federated Malay States.*

From the Laboratory of the University War Hospital, Southampton.

At the present time many workers are engaged in examining convalescents from typhoid, paratyphoid and dysentery. Several equally satisfactory methods are employed for the detection of carriers, but I would urge that the method of preliminary agglutination is more simple and more economical than those in general use and is, at least, as efficient.

The following is the procedure adopted in this laboratory:—

COLLECTION.

The urine is collected in large sterile test-tubes ten inches by one inch, incubated for twenty-four hours at 37° C. and then plated on Endo's fuchsin-sulphite-agar. Incubation is necessary because the urine may contain pathogenic bacilli in very small numbers. On several occasions, in this laboratory, plates inoculated from the fresh urine have remained sterile while there has been a profuse growth on plates prepared from the same urine after incubation.

The fæces are brought to the laboratory in sterilized six-inch petri dishes. The consistency and any abnormal constituents of the sample are noted and a microscopical examination is made for the purpose of detecting protozoa, or the ova of entozoa. With a piece of stiff iron wire, known as bird-cage wire, 10 centimetres long, bent up at one end into a hook 1 centimetre in diameter, a portion of the fæces the size of a large bean is transferred to 5 cubic centimetres of sterile salt solution in a test-tube. The wire is twirled rapidly between the finger and thumb, so that the fæces are beaten up into an emulsion with the salt solution by the revolving hook. The tube with the wire still in it is then incubated for one hour at 37° C.

PLATING.

This is carried out by two methods: (1) Direct plating on Endo's medium; (2) brilliant-green enrichment.

(1) *Direct Plating.*—Two large platinum loopfuls are taken from the emulsion after incubation and are spread on a plate of Endo's fuchsin-sulphite-agar.

(2) *Brilliant-green Method.*—Two large platinum loopfuls of the

emulsion are put into a tube of brilliant-green peptone water (0.5 brilliant-green, 1/100 solution, to 1 litre of peptone water). This is incubated for twenty-four hours and is then spread on a plate of lactose-litmus-agar (one per cent lactose in ordinary nutrient agar with litmus as an indicator).

PRELIMINARY AGGLUTINATION.

The "likely" colonies on the plates are tested at once with agglutinating serums as follows: two combined agglutinating serums are prepared from serums supplied by the Lister Institute of Preventive Medicine.

The first is a mixture of those serums which agglutinate the members of the Eberth group; the second contains those which agglutinate the bacilli of the Gaertner group.

They are prepared by mixing, in two test-tubes, one cubic centimetre of each of the following agglutinating serums:—

Tube 1, Eberth Group	$\left\{ \begin{array}{l} B. typhosus \text{ serum} \\ B. dysenteriae \text{ (Shiga)} \\ B. dysenteriae \text{ (Flexner)} \end{array} \right\}$	one cubic centimetre of each
Tube 2, Gaertner Group	$\left\{ \begin{array}{l} B. paratyphosus \text{ A serum} \\ B. paratyphosus \text{ B serum} \\ B. enteritidis \text{ (Gaertner) serum} \end{array} \right\}$	one cubic centimetre of each

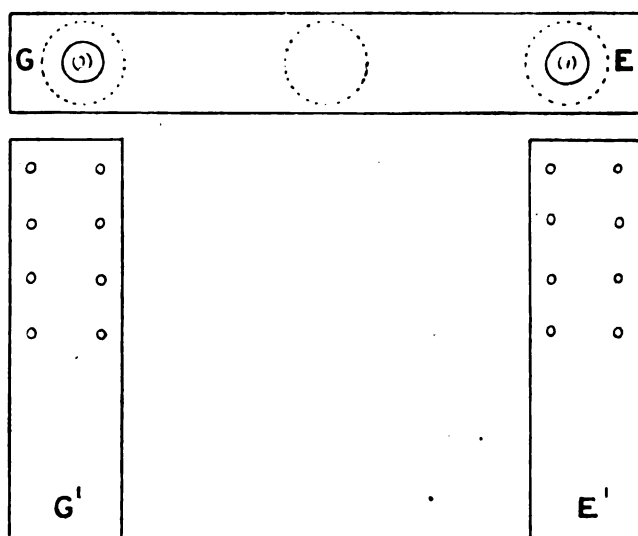


FIG. 1.

Moist-chamber slide with drop of Gaertner serum G, and drop of Eberth serum E. G' = Ordinary microscope-slide with 8 minute drops of Gaertner serum. E' = Ordinary microscope-slide with 8 minute drops of Eberth serum.

The combined serums can be kept in sterile test-tubes for weeks, without losing their efficiency. One phial of each serum, that is three cubic centimetres of the combined serums, is sufficient for the preliminary examination of several thousands of colonies.

In order to apply the test a drop of Eberth serum is put into the

depression at one end of a hollow-ground, moist chamber slide and a drop of Gaertner serum in the depression at the other end. Two ordinary, plain microscope slides are placed at right angles to the hollow-ground slide, one below each of the little pools of serum.

With a pipette drawn out to the fineness of a hair, some of the serum is taken up from the hollow-ground slide and a series of minute drops is placed in rows on the surface of the plain slide; the drops of Eberth serum on one slide and the drops of Gaertner serum on the other (see fig. 1). The drops must not be too large, or they will run down the slides when they are moved.

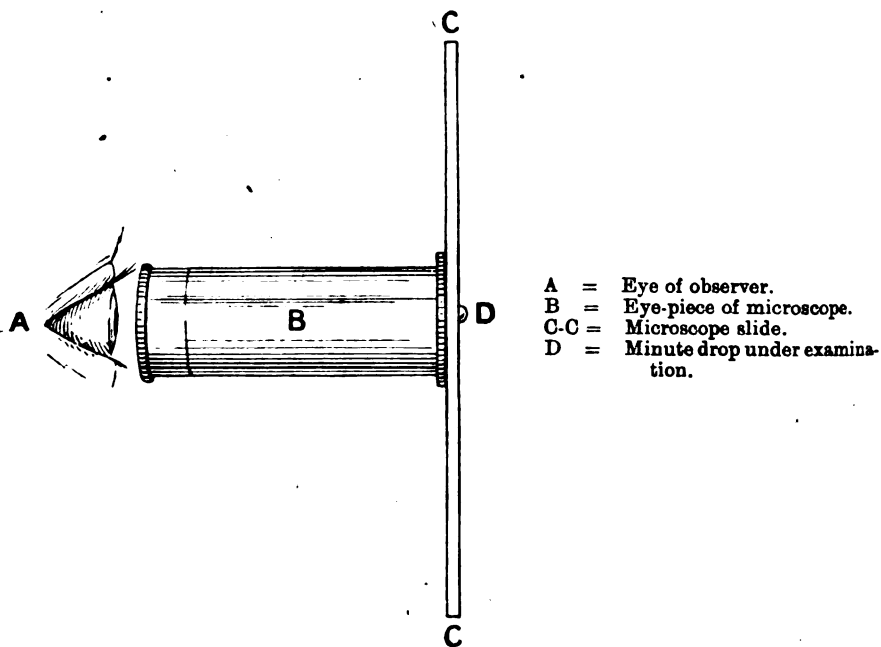


FIG. 2.

With a platinum needle, flattened at the end like a spatula, a portion of the first colony to be examined is emulsified in the top left-hand droplet on each slide.

If the colony consists of typhoid, paratyphoid or dysentery organisms agglutination will take place in one of the two drops within a few seconds. The actual number of seconds depends upon the specific serum employed. Of two serums, almost equal in titre, one may produce agglutination more rapidly than the other. The Lister Institute serums which I have used here cause agglutination to take place on the slide well within sixty seconds.

If there be no agglutination the next suspicious-looking colony is examined in the same way in the next drop of serum on each of the slides.

The occurrence of agglutination is most readily detected by holding up the slide before a dark background, putting the small lens of the eye-piece of a microscope against the back of the slide and looking through the large lens at the other end, which should be held close to the eye (see fig. 2).

In those cases in which a colony agglutinates with one of the combined serums, subcultures are made on three agar slopes. The first is required for agglutination tests, the second for cultural reactions and the third is kept for carrying on the strain. On the following day, the first of these cultures is tested with drops of the three agglutinating serums (separately) which are contained in the combined serum that agglutinated the colony of which it is a subculture. For instance, if the original colony agglutinated with Gaertner combined serum, the subculture on agar is tested in the same way on a slide, with drops of paratyphoid A, paratyphoid B, and enteritidis serums.

AGGLUTINATION TITRE.

When it has been determined which of the specific serums agglutinates the organism, the next step is to find the highest dilution of the serum at which agglutination occurs. For this purpose an ordinary diluting pipette is employed, graduated in nine equal parts by means of a small bead of mercury. Drops of salt solution are placed in a row on a porcelain tile. The first drop contains nine parts, and each of the others contains five. One part of the specific agglutinating serum is added to the first drop, making a dilution of $1/10$. From this, 5 parts are carried on to the second, 5 drops from this to the third, and so on to the penultimate drop from which 5 drops are discarded.

Each drop now contains 5 parts in dilutions of $1/10$, $1/20$, $1/40$, $1/80$, etc.; the last consists of salt solution only. To each drop are now added 5 parts of an emulsion made by adding 5 cubic centimetres of salt solution to a twenty-four hour culture on agar, of the bacillus under test. This will make the dilutions of the specific serums $1/20$, $1/40$, $1/80$, etc.

The drops are now taken up into a long fine pipette, fitted with a teat, beginning with the last drop, the control. Between each drop air is sucked up into the pipette so that there is an air space between each drop and the next, equal in length to the space occupied by one of the drops. Each drop and each space should occupy about one centimetre of the length of the pipette.

After taking up the last drop the end of the pipette is sealed in the peep-flame, and the pipette is floated on the surface of a water bath at 55° C. for two hours.

At the end of this time the tube is examined for agglutination with the eye-piece of a microscope, employed in the same way as mentioned above, and the titre of agglutination is recorded.

The pipette is then placed vertically in plasticine for one hour, when it is examined again with the lens.

The pipettes are made from broken test-tubes by pulling them out in the blow-pipe flame. The capillary tubes, made in this way, are luted with plasticine, into a short piece of glass tubing fitted with a teat (see fig. 3). When the drops have been taken up from the porcelain tile into the pipette and the distal end has been sealed, the teat is carefully removed from the butt, the capillary tube is withdrawn from the plasticine luting and the proximal end is sealed.

The capillary tube is threaded, stitch-wise, through two slits in a small piece of paper, bearing the name or number of the culture, and is floated on the surface of the water bath. A most satisfactory water bath is the ordinary diet tray, supported at each end by a biscuit tin. This bath is very useful for carrying out agglutination tests by Professor Dryer's method, as it will hold a large number of the small metal stands which are employed in that procedure.

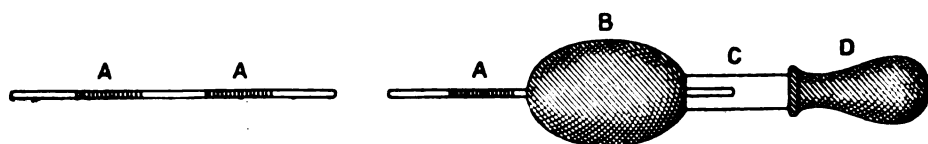


FIG. 3.—A, dilutions of serum with bacillary emulsion; B, plasticine luting; C, glass-tubing; D, teat.

CULTURAL TESTS.

From the second tube of agar cultures the following media are inoculated: litmus milk, peptone water, gelatine and tubes of litmus-peptone-water containing, severally, one per cent of each of the following: lactose, saccharose, dulcitate, glucose, maltose, mannite and dextrine. (Owing to its high price dulcitate has been used in this laboratory as a confirmatory test only.)

It is important to note the changes that take place in these media from day to day, for at least a fortnight, in those cases which appear to be positive. By this means now and then a masquerader may be discovered which would otherwise have escaped detection. Some organisms give the cultural reactions of the Gaertner group up to the seventh or eighth day and then ferment lactose.

For keeping the daily records of the cultural reactions I have found "sectional" paper very useful. It is employed as shown in fig. 4. The fine horizontal lines divide each square into five parts, so that each division equals 0.2 of the height of the square. The proportion of gas in the Durham's tubes is recorded from day to day in much the same manner as the temperature is recorded on a temperature chart.

The tubes after inoculation are placed in labelled jam-pots, which are put into the incubator. When they are examined, they are put in order in a test-tube rack. Plugs of coloured wool are employed to distinguish the different media. A roll of unbleached calico with pockets and elastic loops

(see fig. 5), something like the roll in which the tools of a motor-bicycle are kept, is useful for keeping the tubes in the same order as that in which they are recorded on the sectional paper. When they are removed from their test-tube rack, after inoculation, the tubes are slipped into the pockets of the roll, which is then folded up and put into a jam-pot before being placed in the incubator.

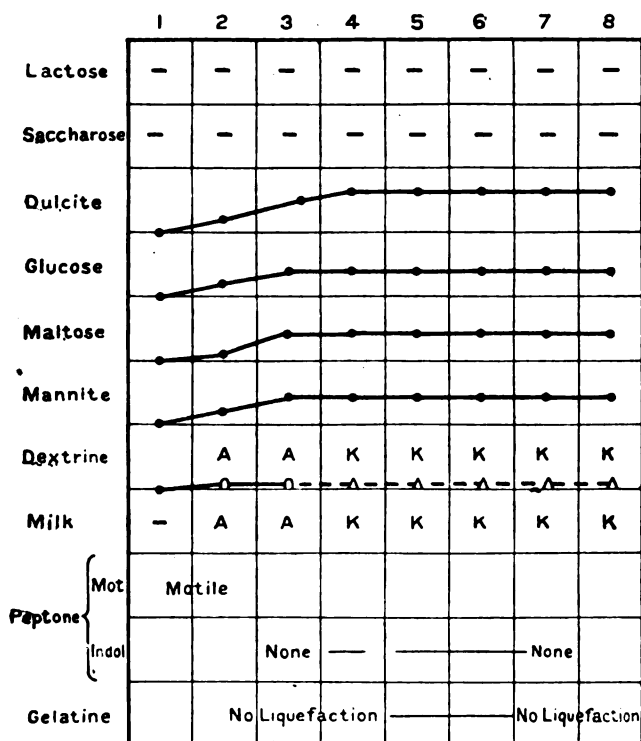


FIG. 4.

● — ● — ● = Acid and gas.
 ○ = Acid bubble.
 △ = Alkaline bubble.
 A = Acid.
 K = Alkali.

The culture in the tube of peptone-water is examined for motility within eighteen hours of being inoculated. On the third, and on subsequent days, the same culture is examined for the presence of indol by the rosindol method. For this purpose about 0.25 cubic centimetre of the peptone-water is taken up in a Pasteur pipette, the end of which has been flamed, and is put into a small tube, such as those used for Dreyer's agglutination test. An equal quantity of paradimethyl-amido-benzaldehyde is added, and, after the reaction has been noted, a similar quantity of sodium persulphate solution. This method is economical in reagents, and enables one to make repeated examinations of the same culture during a period of many days. It is important not to omit this examination for indol.

Morgan has drawn attention to a group of organisms which give fermentation reactions similar to *B. paratyphosus* B, but which produce indol. I frequently met with examples of these bacilli in August and September, 1916.

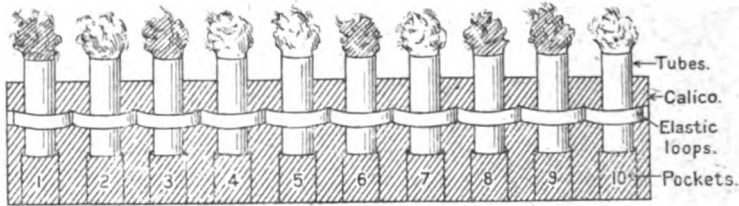


FIG. 5.

SATURATION.

For further confirmation, saturation tests are applied as follows :—

An emulsion of the organism which is being investigated is made by adding one cubic centimetre of salt solution to each of three twenty-four hour cultures on agar slopes.

To 0·9 cubic centimetre of this emulsion is added 0·1 cubic centimetre of the specific agglutinating serum. The serum is thus diluted 1/10.

The tube containing the mixture is placed in a water bath at 45° C. for two hours. The mixture is centrifuged, the supernatant fluid is pipetted off, and to it is added an equal quantity of the bacillary emulsion, making the dilution of the serum 1/20.

The mixture is placed in the water bath for two hours, centrifuged, and an equal quantity of bacillary emulsion added, as before.

After being kept in the water bath for the third time, the supernatant fluid is removed with a pipette, after centrifugalization. The dilution of the serum is now 1/40.

A similar procedure is carried out simultaneously with an emulsion of a stock culture of the bacillus homologous with the agglutinating serum. The serum, after saturation with the bacillus under test, and the serum after saturation with the homologous stock bacillus are now taken, and the powers of each, in agglutinating emulsions of the test bacillus and of the stock bacillus, are investigated and compared with each other and with the agglutination titre of the same serum with these emulsions when it is unsaturated. This method takes up a good deal of time, and any method which does this is in danger of being scamped when work is very pressing. Harvey has shown that it is advisable to carry out saturation tests on all apparently positive cultures. The method which he has employed is much more simple, and takes up less time. He describes it as follows :—

“About 0·5 cubic centimetre of the serum was placed in a watch-glass, and the whole of an agar culture of the bacillus to be tested was rubbed up in the serum to form a very thick emulsion. This was then pipetted into a narrow tube, which was plugged with cotton wool, placed in the incubator at 37° C. for three hours, then removed and centrifuged, and the

clear supernatant fluid used for the subsequent tests, either in sedimentation tubes or simply as a drop on the slide for the macroscopic method, a portion of the cultures being rubbed up in the drop."

THE DRAWBACKS AND ADVANTAGES OF THE METHOD OF PRELIMINARY AGGLUTINATION.

Drawbacks.—The two chief objections to the preliminary employment of an agglutinating serum in the detection of colonies of pathogenic organisms on a plate prepared from the excreta, are:—

(1) Certain non-pathogenic organisms are agglutinated by the specific serum in low dilutions.

(2) Some strains of pathogenic organisms are non-agglutinable, and escape detection.

These objections will be considered separately:—

(1) Harvey, working in India, met with bacilli on several occasions, which were agglutinated at once by paratyphoid serum, but were proved subsequently not to be true paratyphoid bacilli. He writes: "Such bacilli are extraordinarily common in fæces, and it is peculiar that the serum which is most often at fault is that for paratyphoid A." Clemesha has shown how different are the bacteria found at different seasons of the year, and at different places. I have not encountered these bacilli amongst the convalescent soldiers examined in this laboratory. In eight instances colonies were found which agglutinated on the slide with a drop of Flexner serum, but which were not dysentery bacilli. Such organisms are eliminated by the subsequent confirmatory tests: the cultural reactions, the titre of agglutination with immune serum, and by absorption.

(2) Many workers have reported the isolation of enteric and dysentery organisms which are not agglutinable. Strains that do not agglutinate with the low dilutions of high titre serums employed in this laboratory must be very rare indeed. McIntosh and McQueen, in 1914, stated that there was at that time no record of the isolation of an inagglutinable strain from a typhoid carrier. The serums are prepared at the Lister Institute, and diluted from 1/10 to 1/25 before being sent out. As stated before, they are combined into two groups by mixing equal parts of typhoid, Shiga and Flexner serums in one tube, and, in another, Gaertner and the two paratyphoid serums, so that the original dilutions are trebled before the combined serums are employed in the detection of "positive" colonies. To give an example, the typhoid agglutinating serum is supplied diluted to 1/20, and is thus diluted to 1/60, before use. The titre, as stated on the phials, is 1/8,000. It must be extremely rare to find a strain of typhoid, even when first isolated, which will not agglutinate with a serum having a titre of 1/8,000 when diluted to only the extent of 1/60.

Logan states that he isolated non-agglutinable strains from the blood of fifteen cases of undoubted paratyphoid fever. He does not give details of their cultural reactions, nor does he say if they absorbed the specific agglutinins from a paratyphoid serum. An organism which is neither

agglutinated by a powerful paratyphoid immune serum, nor absorbs the agglutinins from it, is not a paratyphoid bacillus, A or B, whatever its cultural reaction may be.

In 345 cases control examinations of the plates prepared from the excreta have been made in this laboratory by the usual fermentation methods, but in no case have pathogenic bacilli been isolated which had not been detected already by the preliminary agglutination test.

Of these 345 patients 288 had suffered from typhoid or paratyphoid fever, 57 had suffered from dysentery.

<i>B. typhosus</i> was isolated from ..	..	..	4 convalescents
<i>B. paratyphosus</i> A was isolated from ..	..	..	2 ..
<i>B. paratyphosus</i> B was isolated from ..	..	..	22 ..
Total ..			28 = 8.11 per cent of 345

In nineteen cases pathogenic bacilli were isolated between the fifth and tenth weeks after the onset of illness.

In six cases pathogenic bacilli were isolated between the eleventh and fifteenth weeks after the onset of illness.

In three cases pathogenic bacilli were isolated between the sixteenth and twenty-fifth weeks after the onset of illness.

Advantages.—The advantages of the preliminary agglutination method are: (1) efficiency, (2) simplicity, (3) speed, (4) economy.

(1) A larger number of colonies can be examined than is practicable by the ordinary methods of subculture and fermentation reactions, so that there is less likelihood of "positive" colonies escaping detection. Henderson Smith states that "there are several ways in which the experienced can save time, and increase the probability of finding any pathogenic organism present. Most important of these is the initial selection of likely colonies." At the present time, however, many of those engaged in this work are not experienced, and in their selection of three or four likely colonies in any given plate they may miss those which are pathogenic.

(2) Owing to the large amount of material which has to be examined, and the absence on foreign service of numbers of experienced workers, it has become necessary to employ unskilled assistants in many laboratories, and in the inoculation of thousands of fermentation tubes some will be contaminated; so that the results are occasionally misleading, and a pathogenic culture is discarded. This is guarded against by carrying out the preliminary agglutination tests. Qualitative agglutination on a slide is quite distinctive, even though the colony under examination be contaminated. The classification of organisms by their cultural reactions is not a simple matter which can be carried out successfully by any one who has access to a table in a text-book. The power of fermenting different sugars is more variable than the agglutinin reaction. Fraser has pointed out how difficult it is to determine from the literature the reactions of the different types of dysentery bacilli. According to Hiss and Russell their *Bacillus* "Y" ferments maltose; others say that it is to be distinguished from Flexner's

bacillus by its lack of power to do so. In the case of *B. paratyphosus* A, when it is freshly isolated, the production of gas with various sugars does not agree with that given in the tables of fermentation reactions in most text-books.

Bacilli are occasionally isolated which give the same fermentation reactions as those of the Gaertner group up to the sixth or seventh day, when they produce acid and gas in lactose. On the other hand, as Fraser has pointed out, some dysentery bacilli ferment lactose in certain media when first isolated. In the case of a carrier of *B. typhosus* in this hospital, the colonies on Endo plates prepared from the urine had red granular centres on each occasion in which the bacillus was present, though lactose was not fermented on subculture.

(3) By the adoption of the method of preliminary agglutination, it is possible to eliminate the "negative" specimens on the third day, and to arrive at a provisional diagnosis with regard to the others by the fourth day, as is shown in the following time table:—

TIME TABLE.

First Day	{	A	Direct plating.	
		B	Inoculation of brilliant-green tube.	
		C	Incubation of urine.	
Second Day	{	D	Examination of direct plating by preliminary agglutination.	
		E	Inoculation of three agar slopes from agglutinating colonies.	
		F	Spreading of plates from brilliant-green tubes.	
		G	Spreading of plates from incubated urine.	
Third Day	{	H	Three agar slopes from E	(1) Titre of agglutination with high titre serum with patient's own blood serum. (2) Sugars, etc., inoculated. (3) Stored for further investigation.
		I	Examination of plating from brilliant-green and from urine.	Negative samples eliminated.
		K	Inoculation of three agar slopes with positive colonies from I	
Fourth Day	{	L	Three agar slopes from K examined as in H.	Provisional diagnosis of positive samples.
		M	Examination of sugars, etc., from H (2).	
Later—Confirmatory tests, such as further cultural reactions and saturation.				

(4) Preliminary qualitative agglutination as a means of detecting pathogenic organisms in the excreta is economical in money as well as in time. Many sugars are difficult to obtain at present, and the price of some reagents, such as the alcohol dulcete, which costs ninety shillings an ounce, is almost prohibitive.

REFERENCES.

- [1] CLEMESHA, Major W. W. "The Bacteriology of Surface Waters in the Tropics."
- [2] FRASER, H. "The Bacteriology of Dysentery in Malaya." Studies from the Institute for Medical Research, Federated Malay States, No. 13.
- [3] HARVEY, Lieutenant-Colonel D. "The Causation and Prevention of Enteric Fever on Military Service, with special reference to the Importance of the Carrier." JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, July, 1915.
- [4] LOGAN, Captain W. R. "The Bacteriology of the Fæces in Diarrhoea of Infants." *Lancet*, November 11, 1916.
- [5] MCINTOSH, J., and McQUEEN, J. M. "The Immunity Reactions of an Inagglutinable Strain of *B. typhosus*." *Journal of Hygiene*, vol. xiii, No. 4.
- [6] MORGAN. Quoted by Ledingham, J. C. G., and Arkwright, J. A., "The Carrier Problem in Infectious Disease."
- [7] SMITH, J. HENDERSON. "The Identification of the Pathogenic Members of the Typhoid-colon Group of Bacilli." *British Medical Journal*, July 3, 1915.
- [8] HISS and RUSSELL. "A Study of a Bacillus resembling the Bacillus of Shiga from a Case of Fatal Diarrhoea in a Child; with Remarks on the Recognition of Dysentery, Typhoid and Allied Bacilli," *Medical News*, 1903, vol. lxxxii, No. 7.

A CASE OF EXPOSURE BY OPERATION OF THE INTRA-PELVIC PORTION OF THE GREAT SCIATIC NERVE.

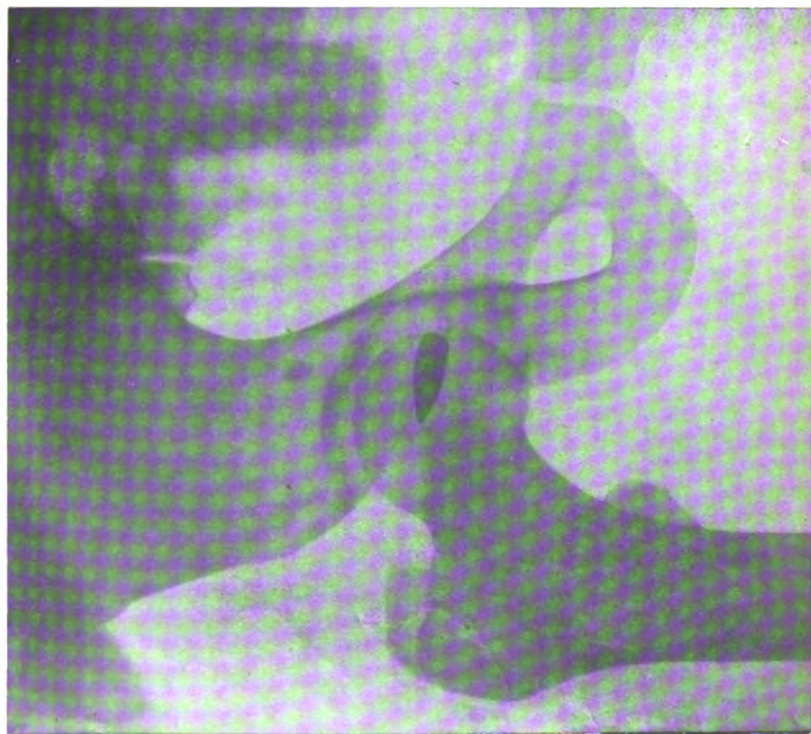
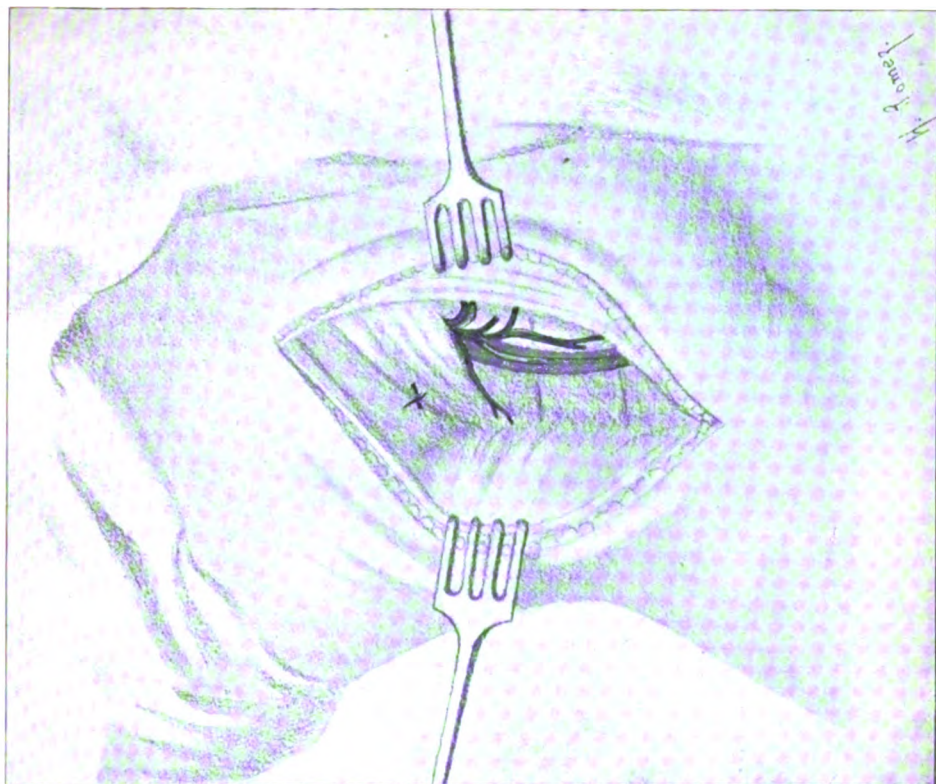
BY LIEUTENANT H. E. RAWLENCE.

Royal Army Medical Corps.

1916. Rifleman S., 1190, aged 23, service five years. Patient was wounded in France on November 6, 1915. He was admitted to the British Military Hospital, Brockenhurst, on November 17, 1915. Whilst in a semi-upright position he was struck by a rifle bullet on the left buttock opposite the anus one inch from the anal fold. On admission to this hospital the wound of entrance was healed. The accompanying X-ray picture, which was taken from behind looking forward, shows the bullet behind the head of the femur. He had had a certain amount of pain in the buttock, but at the time of admission was able to walk comfortably, and was not suffering any inconvenience from the presence of the bullet. When operation was suggested, he said that the bullet's location and extraction, he had been told, would be difficult, consequently he preferred to have it left alone. He was sent to an auxiliary hospital, Class "B." He returned on January 16, 1916, from this hospital and stated that after a walk of between six and eight miles he experienced a dull ache deep down behind the hip-joint. He had had this same pain on walking ever since. He also complained of some sharp stabbing pain behind the left ankle-joint, which became worse at night and in other ways suggested neuritis of the posterior tibial nerve. Another X-ray examination now showed that the position of the bullet had slightly altered. Its exact location could not be determined owing to the great thickness of the patient's thighs. The clinical symptoms made it clear that the bullet was most probably close to the left great sciatic nerve.

Operation.—January 17, 1916. Chloroform was administered by the open method by Lieutenant W. M. Jackson, R.A.M.C. The patient was placed on his right side, and the left knee was slightly flexed. The incision made was about ten inches in length. It was made one and a half inches posterior to that usually made in Kocker's modification of Langenbeck's incision for the posterior excision of the hip-joint. The gluteus maximus was split in its length, exposing the point of exit of the great sciatic nerve from the pelvis, and the muscles on which it lay. The accompanying diagram is a sketch of the structures exposed. The nerve was now carefully examined and the bullet was located inside the great sacro-sciatic foramen behind and above the pyriformis muscle. The bullet was now pressed towards the hip-joint by introducing the finger behind the sciatic nerve lying under the pyriformis muscle. The point of the bullet emerged between the pyriformis and gluteus medius muscles as shown by the x marked in the diagram. The parts near the bullet looked somewhat

Diagram of parts exposed by Kocher's model of Langenbeck's posterior incision for excision of the hip joint.



To illustrate "A Case of Exposure by Operation of the Intra-Pelvic Portion of the Great Sciatic Nerve,"
by Lieutenant H. E. RAWLENCE.

unhealthy, so a drainage tube was inserted. The gluteus maximus was drawn together by two catgut stitches, and the skin incision closed. The drainage tube was removed on the second day. The wound healed by first intention, and the stitches were taken out on the tenth day. Eight days later the patient was found keeping goal on the football field. He was discharged to furlough on February 21, 1916, in the best of health. The bullet was the ordinary German mauser. It was flattened on one side and was therefore probably a ricochet.

DISCUSSION.

This man had passed through several hospitals before arriving in England, and I gather from the reports that the position of the bullet was thought to make its removal difficult. As far as I can make out in the literature the great sciatic nerve has very rarely been exposed or operated on above its exit from the pelvis. Von Baracz operated on a case of sciatica and freed adhesions at the great sacro-sciatic notch. Bardenheuer trephined the ilium and enlarged the anterior spinal foramina to relieve pressure on the roots of the great sciatic nerve. These isolated operations show that some surgeons have gained access to the nerve from behind the hip-joint. The present war has produced many new problems in surgery, and amongst them the question of access to the pelvis for the removal of foreign bodies, and also to secure posterior drainage. Before the year 1900 excision of the hip-joint was more frequently performed than it is now. Langenbeck's incision or Kocker's modification of it was used. It has the great advantage in advanced cases of disease in allowing for posterior drainage. I should like to emphasize the value of this incision. It exposes at once without any cutting or destruction of muscles the whole of the structure lying posterior to the hip-joint, including the great sciatic nerve over about four inches of its course. With very slight pressure above or below the pyriformis muscle the finger can be pushed into the pelvis, towards the front of the sacrum or forwards to the posterior surface of the acetabulum, and the interior of the pelvis can thus be explored. In this case the operation occupied twenty minutes, and though the parts exposed were at a depth of eight inches and over from the surface, the patient had no symptoms of shock, and made an uninterrupted recovery.

I have to express my thanks to Lieutenant-Colonel W. Alpin, I.M.S., for leave to publish this case, for his assistance at the operation, and in the preparation of these notes.

REFERENCES.

V. BARACZ. *Centralbl. Chir.*, 1902, p. 250.

BARDENHEUER. *Deutsch. Zeitschr. Chir.*, lxxvii, p. 137; *Centralbl. Chir.*, 1901, p. 1244.

Clinical and other Notes.

THE RELATIONSHIP OF VINCENT'S ANGINA TO PERIDONTAL GINGIVITIS.

By FRANK E. TAYLOR, M.A., M.D., M.Sc., F.R.C.S., D.P.H.

*Pathologist and Bacteriologist, Queen Alexandra Military Hospital, Millbank, and
Lecturer on Bacteriology, University of London, King's College.*

AND

CAPTAIN W. H. MCKINSTRY, M.B., D.P.H.

Royal Army Medical Corps.

THAT ulcero-membranous inflammatory infections of the buccal cavity may be widely distributed on the mucous membranes of the mouth and gums, and not merely confined to the pharynx and tonsil in accordance with the classical descriptions of Vincent's angina, has been recognized by many observers since this was pointed out by Vincent himself in 1898.

In addition to an ulcero-membranous pharyngitis and tonsillitis (Vincent's angina) he described an ulcero-membranous stomatitis and an ulcero-membranous gingivitis. In all these conditions, two or more of which are not infrequently seen in the same patient, he found that the same micro-organisms were present, viz., the spirillum and *Bacillus fusiformis* of Vincent.

Although Vincent's name is usually attached to these organisms, they would appear to have been first seen and described by Miller, a German dental surgeon in 1882.

At the Queen Alexandra Military Hospital during the last few months we have bacteriologically examined nearly 300 cases of fuso-spirillary infection of the mouth, and have abundantly confirmed the previous findings of the constant presence of these organisms in all forms of ulcero-membranous inflammation of the mouth, either alone or associated with various forms of cocci, bacilli and leptothrices.

In addition to the diffuse ulcero-membranous gingivitis previously described by Vincent and others which is frequently found in association with Vincent's angina there is also frequently met with a more restricted infection of the gums with these fusiform and spirillary organisms, in which the lesions are limited to those parts of the gums which are in immediate contact with the necks of the teeth. This condition constitutes we believe a distinct clinical entity and may accurately be designated fuso-spirillary periodontal or marginal gingivitis—a condition which was fully described by us in a paper read before the Odontological Section of this Society on November 27, 1916.

In addition to its prevalence this affection is of additional interest and importance in that it is often confused with pyorrhœa alveolaris, although it differs from this condition in the absence of pus and pus pockets. Further, the treatment, course and duration, and prognosis of these two affections are essentially different.

In our earlier examinations of cases of Vincent's angina the investigations were restricted to the ulcero-membranous lesions of the pharynx, and to the

differential diagnosis of the condition from other ulcerative membranous infections, particularly diphtheria and syphilis.

Later, the ulcero-membranous conditions were found not to be confined to the pharynx, and many cases of fuso-spirillary gingivitis were observed—often associated with the typical Vincent's angina.

It is, however, the restricted peridental or marginal gingivitis which we have particularly found associated with Vincent's angina, although in a few cases the accompanying gingivitis was of a more diffuse character.

Since our attention was first directed to this association of peridental gingivitis and Vincent's angina we have made a systematic examination of the gums of seventy cases of Vincent's angina, and in every case without a single exception we have found the gums to be affected, the condition in the great majority of cases being a localized peridental or marginal gingivitis. Conversely, out of 150 cases of fuso-spirillary gingivitis the characteristic lesions of Vincent's angina have been present in the pharynx or tonsil of seventy. In all these cases the clinical findings have been confirmed by careful bacteriological examination.

An investigation of the histories of these cases shows the same sequence of events in them all, namely, that the gums were always infected first, and that the sore throat was the more recent condition, having been infected, it would appear, from the gums. In many cases the patients themselves would make no complaint of the gums, but on inquiry it would be found that the gums had been sore and bled more or less freely whenever an attempt was made to use the toothbrush or clean the teeth. This condition of the gums may have been present for days, weeks, or even, in a few cases, years before infection of the tonsil or pharynx supervened.

In some of the chronic cases of peridental gingivitis the patients had repeatedly suffered from attacks of sore throat, and examination in these cases usually revealed evidences of old ulceration of the pharynx or tonsil with loss of tissue, deep crater-like depressions in these organs being often found. In this connexion the following are interesting and instructive histories:—

Case 1.—Second Lieutenant D., Lovatt's Scouts, presented himself for treatment suffering from Vincent's angina of the left tonsil. Peridental ulceration of the gums was also present about the lower incisors. The teeth were sound, clean, and in good condition. After two weeks' treatment by the topical application of an alkaline solution of salvarsan the throat was quite healed and the condition of marginal gingivitis was much improved, though slight bleeding of the gums when touched still persisted, and fusiform bacilli were still present, though in reduced numbers. Owing to the fact that he was then recalled to his regiment no further treatment was undertaken. About the middle of November the right tonsil became sore and painful. The regimental Medical Officer applied boroglycerine, tincture of iodine, and other solutions without success, and so referred the patient back to us on December 5. We found a deep ulcer on the right tonsil, and a relapse of the peridental ulceration about the lower molars. Smears made from both the throat and gums showed the usual picture of fusiform bacilli and spirilla. Swabbing the throat and gums with salvarsan solution was again regularly undertaken and by December 18 the throat was completely healed.

On December 22 the organisms had disappeared from the alveolar margins, and there has been no recurrence either on the pharynx or the gums.

Case 2.—Pte. B., A.I.F., complained of sore throat and two deep ulcers were found on the right tonsil. A soft whitish membranous exudation covered the ulcerated surface, and could readily be removed with a throat swab or platinum loop. This slight manipulation was sufficient to excite somewhat free bleeding. The throat had been sore for two days and great pain was experienced on swallowing. The breath was very foetid, and the lymphatic glands beneath the left angle of the lower jaw were swollen and tender. The gums also showed peridental gingivitis about all the lower incisors, and on examination it was found that bleeding of the gums had been present for the last two years. The teeth were in good order the first and second upper molars having gold fillings. Smears from both gums and throat showed the presence of fusiform bacilli and spirilla. The teeth were thoroughly cleaned by the dentist, and the gums and throat were then painted daily with salvarsan solution. By November 23 the condition of the throat was greatly improved and no bleeding occurred on instrumentation of the gums. On December 6 the throat was well and the gums were nearly healed. On December 15 the throat and gums were free from Vincent's organism.

Case 3.—Pte. C., was sent for the bacteriological investigation of a sore throat of three days duration and of bleeding sore gums of three weeks duration. The sore throat was a typical Vincent's angina, and the sore gums typical peridental gingivitis. The characteristic organisms were present in both conditions.

These few cases may be taken as examples of many which we are encountering daily, and the histories of the cases keep repeating the same sequence of events with monotonous regularity—first the bleeding sore gums which may, or may not have been diagnosed as pyorrhœa, and which may have been present for some considerable time, and then the throat becomes affected, and the typical ulceromembranous pharyngitis and tonsillitis of Vincent's angina is seen. The diagnosis is confirmed by finding the typical organisms in both conditions.

Our experience has been confined to adults, but Vincent's angina is also seen in children, and it would be interesting to learn if the same frequency of peridental gingivitis is observed in association with Vincent's angina in children, and whether in them also the same sequence of events, viz., the peridental gingivitis preceding the Vincent's angina-occurred.

As the result of our investigations we suggest that when a patient complains of a sore throat which presents the character of Vincent's angina it is essential to examine carefully the tooth margins for evidence of peridental gingivitis or conditions diagnosed pyorrhœa, and that smears be made from both sources and examined microscopically for the detection of the causal micro-organisms. When these are found to be present the peridental gingivitis should be adequately treated as well as the Vincent's angina, otherwise the condition is likely to persist indefinitely, or to cause repeated recurrences of the sore throat.

Our thanks are due to Mr. J. Coubro Potter, Laryngologist to the Queen Alexandra Military Hospital, for sending us many of the cases and confirming our results, and to the Commanding Officer, Surgeon-General J. Dallas Edge, C.B., A.M.S., for permission to publish them.

THE TREATMENT OF STAPHYLOCOCCAL INFECTIONS BY
STANNOXYL—FURUNCULOSIS AND ACNE.

(METHOD OF GREGOIRE AND FROUIN.)

BY TEMPORARY CAPTAIN ARTHUR COMPTON, B.A., M.B. (R.U.I.), D.Sc. (N.U.I.).

*Royal Army Medical Corps.**Officer in Charge Military Bacteriological Laboratory, Dorset District; formerly
Research Assistant, Institut Pasteur, Paris.*

FROUIN [1], in pursuing his interesting researches on the action *in vitro* of metals, particularly the rare metals, on different bacteria, has recently been led to investigate the influence of tin and its derivatives on the growth of staphylococci. With Gregoire [2] he has established that this element, its chloride or its oxide, when added to ordinary bouillon culture medium, strongly inhibits the growth under anaerobic conditions of staphylococci; while, under aerobic conditions, the growth of staphylococci is not hindered, but the virulence of the microbe is diminished. That fact, coupled with the observation coming from the district of Beauce that *furunculosis* is an unknown affection among tin workers of the region, formed for Frouin and Gregoire the starting-point for testing *in vivo* the therapeutic value of tin in staphylococcal infections. They found that intravenous injection of the chloride or hydroxide of tin in the rabbit, twelve hours after intraperitoneal inoculation of virulent staphylococci, retarded the death of the animal by several days.

As a result of these experiments Gregoire and Frouin have given us for the treatment of lesions of staphylococcal origin the preparation stannoxyl, which is a combination of metallic tin and its oxide, entirely free from lead, a drug which, already in France [3] has given such promising results in the treatment of staphylococcal infections (*acne*, *furunculosis*, etc.).

In the present paper I propose giving an account of confirmatory results obtained by me with stannoxyl, kindly placed at my disposal by Monsieur Frouin, in the treatment of seven cases of staphylococcal infection.

These cases group themselves under the following headings:—

(1) FURUNCULOSIS.

Case 1.—Lieutenant W., aged 40. Came to see me July 16, 1917, to have a vaccine prepared for two angry-looking boils on the neck, one situated on the left side about half an inch above the collar, the other on the right side at the level of the collar. Patient was in a very excited condition, feeling, as he put it, that he was "in for a bad time." Some years previously he had had a very severe attack of boils, which at the time required drastic surgical interference, the scars from which on the neck and scalp were plainly visible. At visit on July 16, 1917, I opened and expressed pus from both boils, the culture from same giving pure growths of *Staphylococcus aureus*. Boils were swabbed with tincture of iodine, dry dressings—as recommended by Frouin—being applied, and the patient was put at once on stannoxyl internally. After two days' treatment with stannoxyl the tense feeling complained of in the neck had practically gone and the condition was greatly improved, while two days later condition had quite cleared up. No return two months later. Patient only took in all some twenty tablets (comprimes) of stannoxyl.

Case 2.—Drvr. T., aged 26. First seen by me at the laboratory on July 18, 1917, where he was sent to have autogenous vaccine prepared. Three large boils

present on neck, one in a particularly active condition, and many little boils beginning to point, besides numerous scars of old boils. Patient said that four months previously at Birmingham he suffered from a troublesome crop of boils, five of which had to be finally opened, drained and packed with antiseptic gauze before they cleared up. Treatment with a stock vaccine had then been tried and failed. Stannoxyl treatment was begun at once (July 18, 1917), the patient being recommended to take four comprimés (one gramme) per day the first day, six the second, and eight on subsequent days, while continuing the ordinary hospital treatment of boracic fomentations twice daily. On July 27, 1917, only two boils active. Injection of 250 million staphylococci (autogenous vaccine) given. A week later (July 27, 1917) boils not so active, but two tense areas amongst old scars suggestive of deep-seated pus which might point at any time; 500 million staphylococci injected (arm). Seen again August 7, 1917; condition considerably improved, patient felt better, leakage from active boils much less; tense swollen areas mentioned had become smaller, felt harder and more shotty; injection of 750 million staphylococci given. After this date vaccine treatment was discontinued, and stannoxyl, with local dressings, solely relied upon. On August 14, 1917, only two little openings from which occasional leakage of pus and lymph. Ten days later (August 24, 1917), patient practically well, only slight leakage from one little opening, all others healed. Within a week this was closed and patient apparently cured. No return of boils since. In all, some 170 comprimés of stannoxyl taken.

Case 3.—Pte. J., aged 23. First seen August 14, 1917. Boils on posterior aspect of both thighs and buttocks around cicatrices of four large "nose-cap" wounds received in France in April, 1917, from which metal had been removed. Present attack six weeks old, beginning with a boil near one of the wounds. On left buttock the remains of some thirty or forty healed boils could be counted. Had also a boil in full activity on external aspect of right elbow. Pus removed from same gave a pure culture of *Staphylococcus aureus*. About six years ago patient had a severe attack of boils "right over the face, on the arms and legs." Treatment with stannoxyl begun at once, a box of seventy comprimés being given with instructions to take eight comprimés per day, while continuing the hospital local fomentations and dressings. Seen four days later (August 18, 1917), boils on buttocks greatly improved, but a fresh crop showed evidence of breaking out in region of right elbow. Seen nine days later (August 27, 1917), the elbow condition had entirely cleared up, having apparently never come to anything, the condition on the thighs being much the same. Patient was given a second box of stannoxyl with instructions to continue taking eight comprimés per day. After this the case proceeded normally to complete cure, which was attained three days later. On September 10, 1917, there had been no return of boils. In all, about 100 comprimés of stannoxyl taken.

Case 4.—Pte. S., aged 32. Seen August 16, 1917. An active angry-looking boil situated on the outer aspect of right leg, just below the knee, from which about one cubic centimetre of pus was easily expressed. Another boil in process of healing was situated further down the same leg. Over the left knee was an inflamed area of a commencing boil, while further down same leg on anterior aspect of ankle was a boil in process of healing. Stannoxyl treatment was begun at once, the ordinary hospital carbolic fomentations every three hours not being

interfered with. Seen sixteen days later (September 1, 1917), patient was to all intents and purposes cured; there only remained a little inflammatory spot about half way down outer aspect of right leg, as if a new boil was forming. Patient said this had been so for a few days, and was told to report again if anything came of it. He never did so, hence assumed to have been completely cured. Patient had previously an attack of boils on legs fifteen years ago when in India. Quantity of stannoxyl taken—one box of seventy to eighty comprimes.

Case 5.—J. E., civilian, aged 17½. Subject more or less to boils since the age of 13. Seen September 2, 1917, patient was suffering from a boil on left side of neck about size of fairly large bean. A boracic fomentation recommended to clean and soften boil, and on September 4, 1917, a culture was made from the pus. A pure growth of staphylococci was obtained. Internal treatment with stannoxyl begun September 4, 1917, and local dressings of dry boracic lint on boil. Five days later condition had entirely cleared up and there was no evidence of fresh boils. Treatment discontinued. In all, twenty comprimes of stannoxyl taken. As drug had a marked constipating effect, only four comprimes were taken per day instead of eight; which patient had been recommended; bowels kept open with salts.

(2) ACNE.

Case 6.—Pte. B., aged 21, laboratory attendant. Very troublesome acne on face since the age of 12. Condition showed weekly periodicity, in that about once a week there appeared a widespread crop of papules all over the face, eventually becoming pustular, which was most distressing. Between August, 1916, and April, 1917, patient had continuous course of treatment with autogenous vaccine (*Staphylococcus aureus*) at more or less weekly intervals, the doses ranging progressively from 50 million to 5,000 million, and that without the least benefit. Vaccine treatment was therefore abandoned, and treatment with stannoxyl begun June 23, 1917, and continued, eight comprimes per day, till August 8, 1917, during which time some 350 comprimes were taken. The condition rapidly improved with stannoxyl treatment, but between July 8, 1917, and July 14, 1917, patient visited his home in Yorkshire "on leave," and while there he had a more or less full-blown attack. On account of this, on his return I continued him on treatment much longer than appeared necessary after his condition had again cleared up. For a month after treatment was suspended on August 6, 1917; there was no return of the weekly attacks, but occasionally a papule would appear on the forehead, which quickly disappeared, the rest of the face remaining quite clear. Owing to the return of some six papules on the forehead, cheeks and neck, on September 26, 1917, patient was again put on stannoxyl, six comprimes per day. Anew there was an immediate response to treatment; inside a few days condition quite cleared up. This patient's condition being now so perfectly under control by stannoxyl treatment, it is hoped by successive courses of the drug to eventually completely cure him of his complaint. Up to the present patient has taken in all 410 comprimes, about 100 grammes of stannoxyl.

(3) INFECTIVE DERMATITIS (OTHERWISE UNDIAGNOSED).

Case 7.—Pte. D., aged 27. Seen on August 20, 1917, being sent to laboratory for the preparation of autogenous vaccine. Purplish pustular eruption on extensor and flexor aspect of forearms, on back of left hand, on the neck, and a

nodule on upper lip. Condition began six weeks ago while engaged on farm work. A Gram-negative diplococcus and a Gram-positive diphtheroid bacillus isolated on culture, but no staphylococci were found. Seen again a week later (August 27, 1917), when a fresh culture was made from eruption on flexor aspect of forearm in order to confirm above finding in regard to diphtheroid organism in view of preparing vaccine. Culture revealed presence of same diphtheroid bacillus, also of staphylococci. At this visit, in the absence of staphylococci being found in the first culture, the case was considered more suitable for autogenous vaccine, prepared with above diphtheroid organism, than for stannoxyl. However, during next few days, while vaccine was being prepared, the patient was put on treatment with stannoxyl, eight tablets per day being taken. When seen five days later (September 1, 1917), condition very much improved. Stannoxyl therefore was continued, and vaccine treatment abandoned. Patient went "on leave" from September 3, 1917, till September 10, 1917, and was not seen again by me till September 14, 1917. Then patches on forearms were quite healed, and nodule on lip gone, with new skin of a faintly purplish colour formed where latter had been, but two small fresh pustules were present on left wrist, which patient thought might develop. Not having taken any stannoxyl for four days, enough was given to him for five or six days' further treatment. Culture from pustules on wrist showed presence of staphylococci, but no diphtheroid organism found. Seen again September 21, 1917; condition cured and there has been no return since. In all, patient took some 140 tablets of stannoxyl, and during treatment he was obliged to take salts ($MgSO_4$) every other night to keep bowels open.

That stannoxyl appears, therefore, to afford a sure and efficient method of general treatment for such staphylococcal infections as *furunculosis* and *acne*, would seem to be proved by the above cases, confirming as they do the results already obtained in France by Frouin and his co-workers.

The rapidity with which, in these diseases, the infection comes under control is suggestive that, here at least, there is in the metal a curative agent at work, acting probably as in the corresponding anaerobic *in vitro* experiment of Frouin and Gregoire (*loc. cit.*), in which case it would be by producing a soil unfavourable for the growth of staphylococci. Its effect on the growth of staphylococci under aerobic conditions *in vivo* I propose shortly to deal with, in a further paper on the treatment of the "mixed infection" of *pulmonary tuberculosis* by stannoxyl.

My best thanks are due to Major Betts, A.A.M.C., Major Norris, A.A.M.C., and Captain B. Brooke, A.A.M.C., for kindly sending to me, and placing at my disposal, most of the cases dealt with in the foregoing study.

REFERENCES.

- [1] ALBERT FROUIN. "Mineral Media and *Bacillus tuberculosis*," *Compt. rend. Soc. de Biol.*, 1910, vol. lxxviii, p. 915; "Vanadium on *B. tuberculosis*," *ibid.*, 1912, vol. lxxii, p. 1034; "Rare Metals on *B. tuberculosis* and *Asp. niger*," *ibid.*, 1912, vol. lxxiii, p. 640; "Lanthium Sulphate and *B. subtilis*," *ibid.*, 1913, vol. lxxiv, p. 196; "Uranium and Thorium Salts on *B. tuberculosis*," *ibid.*, 1913, vol. lxxiv, p. 282. ALBERT FROUIN and Mlle. S. LEDEBT. "Sodium Vanadate and *B. pyocyaneus*," *Compts. rends. Soc. de Biol.*, 1912, vol. lxxii, p. 981.
- [2] ALBERT FROUIN and R. GREGOIRE. "Tin and Staphylococcus," *Compt. rend. Acad. des Sciences*, 1917, vol. clxiv, p. 794.
- [3] R. GREGOIRE and ALBERT FROUIN. *Bull. Acad. de Med.*, May 20, 1917. HUDELO, *Soc. med. des Hôp.*, May 25, 1917, p. 705. PHOCAS, *Soc. de Chir.*, July 3, 1917, p. 1458.

A NOTE ON LICE AND SKIN DISEASE.

By CAPTAIN J. F. SMITH.

*Royal Army Medical Corps.**Officer in Charge of Skin Department, General Hospital, France.*

ATTENTION has recently¹ been directed by Captains H. C. Semon and H. W. Barber to the importance of pediculosis as a cause of cutaneous disease in the Army. While it has always been recognized that lice can and do give rise to such conditions as impetigo and ecthyma, considerable credit is due to these authors for, firstly, showing that in the Army *Pediculus corporis* frequently deposits its ova on the pubic hair, thus defeating such anti-parasitic measures as are directed only to the clothing and blankets; and, secondly, for showing that the lesions, and still more the distribution of the lesions, are sufficiently characteristic to enable a diagnosis of pediculosis to be made, even in the absence of live parasites or ova.

The object of this brief communication is to show that the contentions of Semons and Barber are entirely borne out by the experience of another base hospital.

In the last 1,047 cases which passed through my hands there were 207 cases of scabies, and 137 cases of pediculosis, the latter in every case carrying live pediculi or ova. There were in addition 144 cases of pyodermia (ecthyma, etc.), in which the distribution of the lesions strongly suggested pediculosis, but in which no absolute evidence was found. (As a majority of my patients come via casualty clearing station it is not unreasonable to assume that for every case arriving with live parasites there is at least one who has been freed from them.)

A further point of some interest emerges. In this series of 1,047 patients there occurred fifty-one cases of "trench fever." No case in which any cause, such for example as tonsillitis, for the pyrexia could be discovered, was included, and all the fifty-one cases showed the symptoms which are recognized as characteristic of "trench fever." Forty-eight of these occurred in patients suffering either from scabies or pediculosis, an incidence of almost ten per cent, while three only occurred among all the other patients, an incidence of 0.59 per cent.

It would be unwise to draw deductions from so few cases, but the above figures certainly lend some support to the theory that trench fever is carried by lice.

CONCLUSIONS.

(1) In the British Expeditionary Force it is not exceptional for *Pediculus corporis* to lay its eggs on the pubic (and occasionally axillary and peri-anal) hair, thus defeating the anti-parasitic measures in ordinary use.

(2) Patients frequently reach the base with marked pediculosis, even after weeks' residence in casualty clearing stations.

(3) Pediculosis is almost certainly a more serious cause of disabling skin disease than scabies.

(4) There is some evidence that lice are the carriers of the infection of "trench fever."²

¹ *Brit. Journ of Derm. and Syph.*, July—September, 1917, "Pyodermia of Parasitic Origin."

² See Interim Report, War Office T. F. Commission. JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, March, 1918.

NOTES OF A CASE OF PNEUMOCOCCAL PERITONITIS WITH
ACUTE GASTRIC DILATATION.

By E. F. SYRETT, M.D.

AND

CAPTAIN W. L. CHRISTIE.

*Royal Army Medical Corps.**(By permission of Lieutenant-Colonel J. Kearney, R.A.M.C., S.M.O., Harwich Garrison.)*

THE rarity of the above condition may make it worth while to record a case of the disease.

Pte. W., aged 20, Middlesex Regt., was admitted on February 12 with a temperature of 104° F., under Dr. Syrett. Pneumonia was diagnosed, first on the left and later on the right side also. The attack was severe, the temperature reaching 104° F. on February 13, 15 and 20; when the temperature fell gradually to 99° F. on the 22nd. The pulse also fell from 132 to 98. Hope was raised that patient was recovering, but vomiting of dark bilious fluid began, and at 6.30 p.m. the same day, in consultation, we found peritonitis and tympanites reaching up to the fifth rib. Obstruction was diagnosed. It was considered that patient was too weak for operation. The vomiting became more copious and urgent. At 11.45 a.m., on the 23rd, the patient died.

A post-mortem was made four hours later, and so much did the stomach fill the abdomen that at first no other organ could be seen, save the liver. The fundus pushed up to the fifth rib, and the greater curvature reached to within an inch of the pubis; the transverse colon was in the true pelvis, where the ileum lay quite empty and collapsed. The colon was contracted also. The duodenum was stretched to a diameter of 2½ to 3 inches. The duodenum-jejunal flexure was normal in size and must have been pressed on by the mesentery, for gas seemed to be entering merely from manipulation movement during examination. There were no adhesions or acute obstructions. There were, however, several flakes of lymph, yellowish-white in colour, thready and toughish as is characteristic of pneumococcal empyema. These came down on to the smaller curvature and fundus from the diaphragm. It would, therefore, appear that the stomach was paralysed by toxæmia acting on its nervous plexuses, and that distension occurred which further caused pressure on the terminal part of the duodenum.

Those practitioners who are robbed, as it were, of their pneumonia cases just as they are on the turn for recovery will naturally feel interested as to the frequency of such a condition. Messrs. Rowland and Turner, "Jacobson's Operations of Surgery," quote ninety-one cases of this rare disease—all children under 15. In thirty cases the peritonitis was secondary to a lesion elsewhere, especially in the lungs and pleura. Primary infections had occurred in the throat or ear in several cases. On gastric dilatation of stomach, Osler, in "Principles and Practice of Medicine," quotes 102 cases. Of these, forty-two followed operations with general anæsthesia. The next largest group occurs in the course of severe diseases or during convalescence. It is noteworthy also that we had an outbreak of pneumonia, sore throats and cerebrospinal meningitis going on during February, when the case occurred, and our past experience leads us to expect appendicitis with this group in the spring season.

A SIMPLE AND EFFECTIVE METHOD OF GIVING QUININE TO MALARIAL CASES IN ORDER TO PREVENT RELAPSES.

BY LIEUTENANT-COLONEL G. J. STONEY ARCHER.

Royal Army Medical Corps.

DURING July, 1917, I noticed that a large number of cases of malaria were returning to hospital which had previously been treated in various hospitals and discharged as cured. In order to prevent this, I determined to try a system of treatment which I had found satisfactory under similar circumstances in Burma. The line of treatment is as follows: On discharge from hospital of each case, a memorandum is sent to the officer commanding, and the medical officer in charge of the unit to which the man belongs and to which he is proceeding. This memorandum states that the man has received hospital treatment for malaria but, in order to prevent relapses, it is necessary that he should receive further out-patient treatment on the following lines, viz: To receive ten grains of quinine three times a day for three consecutive days three times a month, and in order to make it easy to remember, it is recommended that these days should be those days in the month in which 1, 2 and 3 occur, viz., 1st, 2nd, 3rd, 11th, 12th, 13th, 21st, 22nd, 23rd, and that this treatment should be continued for three months; arsenic and iron tonics being given in the intervals between the quinine treatment at the discretion of the man's medical officer. Should the man be moved from one station to another during this course of treatment, instructions are to be sent to the medical officer at the man's new station informing him of the treatment he is receiving and letting him know how long it will be necessary to continue in order that the patient may have the full course of three months.

In accordance with "Provisional Instructions for the Treatment of Cases of Malaria," the patient is now also given a bottle containing twenty five-grain tabloids of quinine, with written instructions as to how he is to take them in case of emergency if he is not within immediate reach of a medical officer.

The above treatment was started in the Cork district in the end of July, 1917, and, since its inception, the medical officer in charge of the malarial wards reports that he cannot trace a single case of a man returning with a relapse where the above treatment was carried out; and, at the present time, we have not a single malarial case in the hospital, whereas, before its adoption, there were regularly between twenty and thirty in-patients in the Central Military Hospital. Nearly all were cases which had been infected at Salonika, and, during their stay in hospital, seemed particularly resistant to treatment.

The blood of all cases suspected of suffering from malaria which occur in the Cork district is sent to the bacteriologist at the hospital for examination and report. Of such specimens which were sent during July, forty-nine on examination were found to be positive as regards the malarial parasite; during August, twenty-two; during September, eleven; during October, four; and, up to date (November 24), this month, nil.

The treatment is simple, easy to remember, involves no risk to the patient and can be carried out without any apparatus in small out-stations, and, in this respect, has advantage over the intravenous injection of quinine or salvarsan, etc.

No known treatment at present appears to be able to deal satisfactorily with

the parasite when it is as it were hibernating in the tissues, but this mode of treatment attacks it vigorously if it once comes out to go through its cycle of development. This is the second time in which I have had personal experience of satisfactory results from this method of treatment.

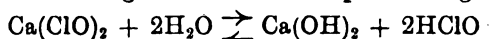
THE STABILITY OF AN ALKALINE HYPOCHLORITE SOLUTION.

BY SECOND LIEUTENANT A. F. McCULLOCH, R.F.A., M.A., B.Sc.
Research Chemist in Bacteriology, Edinburgh University.

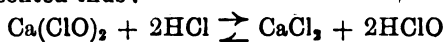
AN alkaline hypochlorite solution has been put on the market as an efficient water sterilizer. This led me to investigate the stability of such a solution and its value as a sterilizer for use in tropical countries. The solution contained calcium hydroxide, calcium hypochlorite and sodium hypochlorite, and the average amount of available chlorine was 3.5 per cent; 0.35 per cent chlorine was present in the free state.

The available chlorine was estimated as follows: Two cubic centimetres of the solution were added to 100 cubic centimetres distilled water, 10 cubic centimetres of twenty per cent acetic acid and excess of a solution of potassium iodide (1 in 2) were then added and the iodine titrated with N/10 sodium thiosulphate and starch. The sodium thiosulphate was finely powdered and washed well with alcohol and ether and then dried. Acetic acid was used instead of hydrochloric as chlorate was found present. Hydrochloric acid breaks up chlorate, liberating chlorine. Twenty per cent acetic acid was found to have an unappreciable effect on chlorate.

The presence of the calcium hydroxide tends to keep the hypochlorite from breaking up. Water hydrolyses the hypochlorite forming hydroxide and free hypochlorous acid, which being unstable breaks up liberating chlorine:—



It is evident from this reversible equation that if the hydroxide be increased, the hypochlorous acid must decrease in order to maintain equilibrium. An acid has the opposite effect. Instead of maintaining hypochlorite the acid drives the action forward, represented thus:—



An interesting point thus arises. Is all the "available" chlorine liberated on dilution, and, if so, is the liberation due to dilution or to the carbonic acid in the water?

EFFECT OF INCREASE IN TEMPERATURE.

Two ground-glass stoppered bottles A and B were filled with the solution, one of which, B, was waxed over and stopper tied down.

Examined December 28, 1916:

Available chlorine 3.67 per cent

Put into thermostat at 37° C. (99° F.), 12 noon, December 30, 1916.

Examined Bottle A at 12 noon, January 2, 1917, after three days:

Available chlorine 3.67 per cent

Examined Bottle A at 12 noon, January 6, 1917, after seven days:

Available chlorine 3.55 per cent

Examined Bottle A at 12 noon, January 13, 1917, after fourteen days :

Available chlorine 3.41 per cent

Examined Bottle A at 12 noon, January 21, 1917, after twenty-two days :

Available chlorine 3.31 per cent

Examined Bottle A at 12 noon, February 23, 1917, after fifty-five days :

Available chlorine 0.80 per cent

Examined Bottle B at 12 noon, February 23, 1917, after fifty-five days :

Available chlorine 0.88 per cent

Two ground-glass stoppered bottles, A and B, were filled with the solution, one of which, B, was waxed over and stopper tied down.

Examined January 16, 1917 :

Available chlorine 3.60 per cent

Put into thermostat at 50° C. (120° F.), 12 noon, January 16, 1917.

Examined Bottle A at 12 noon, January 18, 1917, after two days :

Available chlorine 3.38 per cent

Examined Bottle A at 12 noon, January 21, 1917, after five days :

Available chlorine 3.25 per cent

Examined Bottle A at 12 noon, February 23, 1917, after thirty-eight days :

Available chlorine 1.50 per cent

Examined Bottle B at 12 noon, February 23, 1917, after thirty-eight days :

Available chlorine 1.52 per cent

EFFECT OF SUNLIGHT ON THE SOLUTION.

Samples were put up in various coloured bottles, exposed to the direct rays of the sun for four or five hours per day, and to diffused light during the remainder of the day.

(1) Clear ground-glass stoppered bottle. Cork tied down and covered with collodion. After a few minutes' exposure to sunlight bubbles commenced to rise in the liquid and continued to do so as long as the bottle was exposed to direct sunlight.

Available chlorine before exposure to sunlight 3.67 per cent

Exposed to sunlight at 12 noon, January 3, 1917.

Examined noon, January 6, 1917 :

Available chlorine 2.49 per cent

Examined noon, January 13, 1917 :

Available chlorine 1.17 per cent

(2) Light blue coloured bottle. Same phenomenon observed as with clear glass bottle.

Available chlorine before exposure to sunlight 3.67 per cent

Exposed to sunlight at 12 noon, January 6, 1917.

Examined noon, January 15, 1917 :

Available chlorine 1.81 per cent

(3) Light brown-coloured bottle. No gas evolution observed.

Available chlorine before exposure to sunlight 3.62 per cent

Exposed to sunlight at noon, January 10, 1917.

Examined noon, January 15, 1917 :

Available chlorine 3.43 per cent

(4) Dark green-coloured bottle as sent out by firm. No gas evolution observed, but numerous gas bubbles formed gradually on inner walls of bottle.

Available chlorine before exposure to sunlight 3.15 per cent

Exposed to sunlight at noon, January 10, 1917.

Examined noon, January 15, 1917:

Available chlorine 3.00 per cent

The effect of sunlight on the solution is thus the same as on a solution of bleaching powder. A solution of bleaching powder kept in the dark for several weeks suffers little less in the amount of its available chlorine but deteriorates rapidly on exposure to sunlight in clear glass vessels.

AMOUNT OF CHLORINE LIBERATED ON DILUTION WITH DISTILLED WATER.

The carbonic acid in the water was estimated by titration with N/200 sodium carbonate and phenolphthalein, except where the carbonic acid was present in large amounts, when N/20 was used. The chlorine was estimated by adding potassium iodide solution and titrating with N/500 sodium thiosulphate and starch. The dilute solution of sodium thiosulphate was found to work quite satisfactorily, although the end point with starch was not very well defined.

Titre N/10 sodium thiosulphate of two cubic centimetres of solution diluted and acidified, i.e., titre representing total available chlorine is 2 to 16.48 cubic centimetres.

Dilution, 1 c.c. of solution in	Titre per 100 c.c. water of N/200 sodium carbonate	Titre N/10 sodium thiosulphate of 2 c.c. solution	Titre N/10 sodium thiosulphate after forty-eight hours
0 ..	1.30 c.c.	0.15 c.c.	..
50 ..	1.30 ..	4.00 ..	4.00 c.c.
250 ..	1.30 ..	5.45 ..	5.40 ..
500 ..	1.30 ..	6.50 ..	6.55 ..
1,000 ..	1.30 ..	6.45 ..	6.50 ..
1,500 ..	1.30 ..	6.72 ..	6.80 ..
3,000 ..	1.30 ..	7.10 ..	7.15 ..
15,000 ..	2.25 ..	6.95 ..	..

A dilution of one cubic centimetre in 15,000 of water is equivalent to one part of chlorine to 430,000 of water.

AMOUNT OF CHLORINE LIBERATED ON DILUTION WITH DISTILLED WATER CONTAINING CARBONIC ACID.

Dilution, 1 c.c. of solution in	Titre N/200 sodium carbonate per 100 c.c. water	Titre N/10 sodium thiosulphate per 2 c.c. of solution
50 ..	11.00 c.c.	4.72 c.c.
250 ..	11.00 ..	6.25 ..
500 ..	11.00 ..	6.85 ..
1,000 ..	7.50 ..	6.76 ..
1,500 ..	7.50 ..	6.96 ..
3,000 ..	6.90 ..	10.90 ..
3,000 ..	80.20 ..	16.40 ..
15,000 ..	14.47 ..	10.45 ..
15,000 ..	24.88 ..	12.90 ..
15,000 ..	33.00 ..	15.98 ..

AMOUNT OF CARBONIC ACID IN NATURAL WATERS.

Sample	Titre N/200 sodium car- bonate per 100 c.c. water
Cannamore Water Supply. No. 1 Well ..	11.80 c.c.
Cannamore Water Supply. No. 2 Well ..	10.20 ..
Adigaratti Well Water	11.97 ..
Adigaratti Spring Water	4.10 ..
Madras Water Supply. No. 1 Tank ..	2.90 ..
Madras Water Supply. No. 2 Tank ..	12.64 ..
Chevayor Well Water	11.50 ..
Tap Water, Laboratory, Wellington ..	2.25 ..

From these experiments it is evident that this alkaline solution of hypochlorite is not much more stable than bleaching powder, and is of little use as a stable sterilizer in tropical countries. The amount of chlorine liberated depends on the acidity of the water, and in no case of the water samples examined was the amount necessary to liberate all the available chlorine found to be present.

I am deeply indebted to Major W. W. Browne, R.A.M.C., Officer Commanding Enteric Convalescent Depot, Wellington, and to Major G. S. Wallace, R.A.M.C., D.A.D.M.S. (Sanitary), Secunderabad Division, for permission to do the above work in the Divisional Laboratory, Wellington, India, during my convalescence.

Lecture.

CLINICAL AND PATHOLOGICAL CO-OPERATION.¹

BY CAPTAIN P. H. BAHR,
Royal Army Medical Corps.

THE subject for discussion to-night is undoubtedly a controversial one and, though there is a natural tendency for laboratory workers to be dogmatic on subjects to which they have devoted particular attention, yet I will endeavour to be as little didactic as is possible. The title I have chosen for this paper is one, which interpreted to its widest sense, is of vital interest to us all; by that I mean the collaboration between the clinician and the pathologist so as to arrive at a sure and as speedy a diagnosis as possible, one which will not only be of benefit to the patient, but also to the Army and, ultimately of course, to the country which we serve. I think one can say that there has been on the whole too great a tendency in the past for the clinician and the pathologist to work in watertight compartments and, in certain quarters, a tendency on the part of the clinician to rely too much upon a pathological diagnosis which is perhaps unsupportable by clinical data and which a short consultation in the wards or in the laboratory would soon have adjusted.

I would like to see the clinician much more often in the laboratory and the pathologist in the wards, both acting in a consultative capacity, and I would like to see it established as a rule that a pathological diagnosis which does not agree with the clinical signs should be regarded every bit as unsatisfactory as a clinical diagnosis which does not tally with the pathological report.

To quote Emerson in the preface to his well-known "Clinical Diagnosis," he says: "The function of the clinical laboratory worker is to aid the ward worker. The findings of the former are seldom conclusive and must be interpreted in the light of the ward findings; especially is this true now that functional diagnosis is the goal. . . . The clinical chemist must first be a good clinician and secondly a chemist; he should remember that, even from a laboratory point of view, his

¹ An address delivered before the Cairo and Delta District Medical Society on December 15, 1916.

stethoscope is of more importance than the microscope, his percussion finger than the whole outfit of chemical apparatus."

The modern pathologist cannot afford to disregard clinical phenomena. I will now give you a few details of what I mean based upon my experience as pathologist and clinician during the last two years of military practice as well as upon a varied tropical experience during the last seven years.

I have long been of the conviction that an intimate knowledge of Tropical Medicine is almost essential to every clinician and pathologist practising in the East, and I look forward to the day when a knowledge of what is now a speciality may become part of the ordinary medical curriculum. Now the essence of Tropical Medicine is a study of the blood, and if possible, it is a still higher factor here in Egypt, situated as this country is in a zone common to diseases of temperate and those peculiar to tropical climates.

I shall deal first with the aid which can be derived from a simple blood examination of the pyrexias of this country. Firstly it is advisable to examine the blood for the malarial parasite in every case of fever. The discovery of this parasite in an ordinary Leishman-stained film is an easy matter, and such a film should be examined in every case. This is of vital importance, because it is the only fever for which we possess an absolutely specific drug in quinine.

There is an idea abroad that the malaria parasite can only be found in the peripheral blood during a short period immediately preceding and following the malarial rigor. This I might say is a complete fallacy as regards the benign forms of malaria—the benign tertian, which is extremely common, and the quartan, which seems to be an extremely rare parasite in this country.

As regards the malignant or sub-tertian parasite the case assumes an entirely different and much more serious complexion. I would like to remind you that only the youngest and the most mature (i.e., the ring and the crescent) forms of this parasite are found normally in the peripheral blood. The rest of the cycle, of which specimens have been exhibited for your inspection to-night, takes place in the internal organs—such as the brain, spleen, bone-marrow, pancreas and intestinal capillaries. From the blood stasis thus produced in a non-immune subject the most serious symptoms, dangerous to life itself, may be suddenly produced. The symptoms elicited vary according to the organ attacked—thus we may get hyperpyrexia, this is often named heat-stroke; coma; the so-called sun-stroke of West Africa and other tropical countries; conditions resembling appendicitis, cholera, intestinal obstruction, rheumatism, acute nephritis, pernicious anæmia, malignant jaundice (often misnamed yellow fever, the bilious remittent fever of the tropics) or it may even produce blackwater fever itself. All these conditions can be promptly cured with an early and efficient dose of quinine. It is therefore of the utmost importance to examine the blood at the earliest possible moment. But may I beg you not to do as often as has been done in the past, when treating with such suddenly developed and calamitous symptoms, to await a pathological diagnosis, which cannot be rapidly obtained, before exhibiting quinine, but rather to take a blood-smear and forward it to the nearest laboratory, immediately after examining the patient, and then to administer quinine before awaiting the result, which might take days to arrive. If this practice were invariably conformed to, I should be unable to exhibit some of

the microscopical post-mortem specimens you will see to-night. An intelligent appreciation of the life-history of this parasite will soon convince you that in the majority of cases of fresh infections the parasite may not be present in the peripheral blood for thirty-six hours or more from the commencement of the attack, and before that period has elapsed some patients may be dead or in too serious a condition for the quinine to act. It is therefore important to give quinine immediately in all cases exhibiting serious symptoms of this sort, in whom either a pathological diagnosis cannot be obtained or in whom such diagnosis is unsatisfactory from a clinical point of view. You may take it as a general rule from experience gained on the canal zone, as well as elsewhere, that a pyrexia followed by a rigor occurring in a malarious district during the forenoon or early afternoon is almost invariably of malarial origin, and it is necessary to bear in mind, as a corollary of this statement, that cases of malignant malaria may and do occur without any pronounced pyrexia at all—the so-called algide forms. I would once more remind you that, though the benign forms may be trivial and do not warrant the invaliding of an individual, the malignant form is a different matter altogether.

The diagnosis of relapsing fever is generally an easy matter, as the temperature chart is so typical and the spirochæte is so easily found in a properly stained film (carbol fuchsin being the best stain), but it is necessary to keep in mind that the spirochæte very frequently disappears from the blood-stream about forty-eight hours before the crisis, and, unless this fact is recognised, many cases which would otherwise be diagnosed on clinical grounds as relapsing fever will be missed for want of a pathological confirmation.

As regards the procedure to secure a diagnosis in cases of pyrexia in which the malarial parasite or the spirochæte cannot be found, we can obtain a great deal of information, if not a probable diagnosis, from the correlation of the temperature chart together with a total and a differential leucocyte count. I should like to impress upon you that one without the other is useless, and that, in order to obtain the necessary accurate information, the films for the differential count should be made in a particular way, and that they should be stained with hæmatoxylin and eosin. I find that any other stain gives, owing to specific reactions for glycogenic granules, etc., a totally erroneous idea of the due proportions of the different varieties of white cells present in the film. At least a total of 300 cells should be counted and a considerable practice in this procedure is necessary. A leucopenia of 2,000 to 3,000 whites with a high mononuclear count, i.e., from fifteen per cent upwards (by the large mononuclear cell I mean the large hyaline cell with kidney-shaped or elongated nucleus of text-books) strongly indicates a persistent protozoal infection, such as malaria, leishmaniasis or trypanosomiasis. The latter two diseases of course are of infrequent or of extremely rare occurrence in this country, but may presumably occur from time to time in troops hailing either from the Sudan or East Africa. Now, a continued pyrexia which does not respond to quinine together with a reduction in the number of red cells with a differential leucocyte count such as I have described ought to lead the clinician to puncture the spleen or liver for the Leishman-Donovan body and the pathologist to make a long-continued search of the blood for the trypanosome. A leucocytosis, on the other hand, with an actual increase of the polymorphonuclears over seventy-five per cent in a patient with a continuous nocturnal

pyrexia of a septic type together with a peculiar pallor of the facies and, it may be, with symptoms of a right pleurisy, strongly suggests the probable diagnosis of liver abscess. Such a patient may or may not have given a history of a previous dysentery with the presence of the *Entamoeba histolytica* or its cysts in the stools. In cases of this nature the therapeutic test alone—i.e., the strenuous exhibition of emetine both orally and intramuscularly administered—will alone decide the diagnosis. And I am glad to say many favourable results have latterly been recorded as a result of this procedure. At all events, in amœbiasis of the liver or of the gut it is absolutely necessary in the interests of the patient to act energetically and promptly without a moment's hesitation.

Now a slight rise in the mononuclear count, together with a decided leucopenia occurring on the third or fourth day of the pyrexia, if associated with typical clinical phenomena such as a bradycardia, is characteristic of three tropical fevers—yellow fever, dengue and phlebotomus fever. The latter two of course are commonly met with in this country, and the subsequent course of the fever will naturally decide the diagnosis. As far as I know there is no blood change peculiar to seven-day fever. The saddle-backed character of the chart alone can render the diagnosis in this case.

The season of the year at which these fevers occur is of importance, phlebotomus fever occurring either in the early summer—i.e., June or in the autumn (the latter part of August and September), when the insect transmitter is most abundant, while dengue generally only occurs during the hottest part of the year—i.e., July and early August, though epidemics have been exceptionally recorded in October. High atmospheric temperature appears to be one of the conditions it demands, and when perhaps the breeding season of *Culex fatigans*, the transmitting mosquito, is at its height. Unfortunately for diagnosis, the blood-picture of undulant fever or Malta fever is in no way characteristic. But a continued diurnal and persistent lymphocytosis (i.e., a rise above thirty per cent) may be taken as indicating that the pyrexia is of tubercular origin. An eosinophilia of over five per cent without a leucocytosis in this country is almost diagnostic of some helminthic infection such as the ascaris or the ankylostome or the urinary bilharzia. But a high eosinophilia of twenty to thirty per cent or over, together with a total leucocytosis of 10,000 to 15,000 white cells, in a patient with anæmia, emaciation, enlarged liver, tenderness over the gall-bladder and often urticaria as well, should lead the pathologist to search long and on several occasions with a low-powered lense for the ova of the rectal bilharzia. There is no doubt that these cases—a chart of one of which has been exhibited this afternoon—suggest at first sight enterica. Rectal bilharzia (*B. mansoni*) then, which is occurring among the troops in Egypt, produces a systemic disease identical in its clinical features with "Katayama disease," due to the allied *Schistosomum japonicum* in Japan. This is an entirely new clinical fact, and the credit of the discovery belongs to the staff of the Third Australian General Hospital. On the other hand the urinary bilharzia appears to produce no such marked systemic disturbance and only a slight eosinophilia.

I next propose to deal shortly with the serum diagnosis of enterica and Malta or undulant fever. At the outset I might say that my statements are based entirely on the readings obtained by Captain Garrow's agglutinator, from which

I venture to say results of very great military importance have been obtained. With reference to the diagnosis of enterica we learn that:—

(1) Any reading of a titre under 1 in 320 in a person who has been inoculated within the past year with a vaccine of enterica—"T." or "B."—must be disregarded as of any diagnostic importance.

(2) The residual agglutination titre remains at this figure for a year or more.

(3) The "A." agglutinins do not persist to anything like the same extent as the other two, and it is rare to find a case with an agglutination titre to "A" of over 1 in 40 six months after a "T.A.B." inoculation.

The value of a serum diagnosis is still unimpaired in cases in whom a blood culture cannot be obtained or in which it is too late to obtain it. Supposing then the titre either to "T.," "A." or "B." be found to rise after repeated Widal tests from the ninth to the sixteenth day of the disease the case may be justly regarded as of being that particular infection.

Blood culture still remains the most certain means of diagnosis in enterica, but apparently this can only be expected in not more than 30 per cent of cases in hospital practice. Personally I place considerable reliance on a positive result of urine culture as indicating the particular infection from which the patient suffered. But it is otherwise I think in the case of stool cultures, for instances have occurred in which a certain bacillus, say para. B, has been obtained from the stool in cases which certainly suffered originally from para. "A" septicæmia, the former bacillus having presumably previously existed in the intestinal canal as a saprophyte.

The serum diagnosis of Malta and para-Malta fever presents certain characteristics which recent experience has verified. Firstly, the agglutinins appear in the blood only after a considerable period of pyrexia, say three weeks or more, and then a positive agglutination may occur only in a low dilution of 1 in 10 or 1 in 40. Secondly, in cases with a high agglutinin serum-content a marked inhibition zone occurs: that is, the serum, owing apparently to the presence of anti-agglutinins, may not agglutinate the specific organism in lower dilutions than 1 in 160, but may strongly agglutinate the organism from that figure upwards. As regards the clinical aspect of Malta fever in this country, the temperature charts are by no means always typical, and I have recently seen a series of cases of para-Malta fever which resembled closely those of miliary tuberculosis, but it has been pointed out that a persistent maximum rise of temperature daily at 2 p.m. is nearly always in itself diagnostic of Malta fever. I think we should remember then that para-Malta fever is not of infrequent occurrence in this country and that in its serum reactions the *paramelitensis coccus* is quite distinct from the original *melitensis* strain.

The diagnosis of dysentery exhibits in the closest possible manner the point I wish to emphasize to-night, for it demands, more than any other, the closest co-operation between the physician and the pathologist. It is necessary to bear in mind that the specific cause of the commonest forms of dysentery in this country—the entamœba and the dysentery bacillus are both delicate organisms and die out in a very short time after the stool has been passed; therefore a microscopic examination of a stool specimen which has stood for four hours or more can be of no value whatever; the amœba will be dead and therefore non-motile; and I hold that this is impossible for the most practised microscopist to differentiate in this state between the dead amœba, and any other dead and disintegrating cell, such as

are found in such numbers in any dysentery stool. In freshly passed stools living and active amœbæ containing ingested red cells should be passed in 90 per cent of all amœbic cases, and the diagnosis thus becomes an easy matter, and I think that Lieutenant-Colonel Wenyon's rule, that any active amœba with ingested red cells in a dysentery stool should be regarded as the *Entamœba histolytica*, is an extremely sound one to follow.

It is highly necessary that the clinician himself, in order to bring about this utopian state of affairs, should inspect all dysentery stools himself, but more especially those he sends to the laboratory for diagnosis. In any case—whether amœbic or not—it is useless to send fæculent stools when the patient may be from time to time passing ones consisting almost entirely of blood and mucus, for in both diseases the specific cause is found only in the pathological exudate and not in the fæces themselves. One ought to bear in mind that a class of diarrhœas of amœbic origin does undoubtedly exist in which the amœbæ are only intermittently excreted and these account for the remaining cases in which the specific cause cannot be found during the first microscopic examination. Therefore should the clinician be satisfied that from his own point of view the pathological report is unsatisfactory, he should not rest content with the result of a single microscopical examination of his patient's stool.

I think from what I have told you, that you will bear me out that by itself the diagnosis of dysentery constitutes the strongest plea for the decentralization of simple laboratory work such as has been attempted latterly here in Cairo, and that every hospital in the tropics should have its own laboratory, however small, for the diagnosis of these conditions on *the spot*.

The question arises whether it is possible to differentiate between the dysenteries on the macroscopic appearances of the stool. I think it is by no means always possible to do so, but as a general rule the amœbic stool contains small clots of mucus, together with small clots of blood intimately mingled with the fæcal contents, thus giving the appearance of "anchovy sauce." I must apologize for the very disagreeable habit, peculiar to our profession, of comparing pathological exudates to articles of diet, but naturally their exact appearance depends, as indeed also in the bacillary form, on the situation, condition, and extent of the lesions; on the other hand, the stools passed in the early stages of bacillary dysentery resemble nothing more than red-currant jelly, or sometimes frog's spawn, while in the more advanced stages they have been compared to meat washings, due to the hæmolysis of the red cells and the consequent diffusion of the hæmoglobin and its decomposition products into the surrounding mucus.

In the microscopical examination I lay great stress on the cell exudate, as not only differentiating the two forms, but as also indicating the stage of the disease and the ultimate progress of the patient. Briefly then the presence of a number of macrophage cells—that is a large hyaline cell twenty to thirty microns in diameter, containing chromatic bodies and often red cells as well, but with no very definite structure—together with a large portion of pus cells, relatively few red cells, and few visible bacilli, indicates a bacillary infection and suggests a suitable stool for culture. These macrophage cells I have just mentioned are very important, as they have often been mistaken by the uninitiated in the past for amœbæ, and being derived, as I have good reason to believe, from the submucosa, their continued presence in the stool is of favourable import as indicating that the

repair of the tissues is taking place. On the other hand, bile-stained disintegrating pus cells and the intestinal epithelium, together with numerous bacilli in the microscopic field, denote that an extensive necrosis of the mucosa has taken place. Such a stool is quite unsuitable for culture and in many such cases I have been able to obtain a culture of the dysentery bacillus from the mucus membrane post mortem when I was quite unable to do so from the stool during life. The failure, then, to obtain the specific bacillus from the stool during life does not invariably mean that the case is not one of bacillary origin. Under the circumstances it seems to me a waste of time and material to demand, as has been done, two negative examinations of the stools of a patient convalescent from bacillary dysentery before his discharge from hospital. This is a most tedious practice and endeavours to find the specific dysentery bacillus in a fæculent stool are rarely, if ever, successful.

I sincerely think that this practice ought to be discontinued as tending to keep patients in hospital longer than necessary and as being a quite unpractical procedure. It is like looking for a pin in a haystack.

The culture of the dysentery stool presents certain peculiarities and it is impossible even with a pure blood and mucus stool and the most improved technique to render a definite report before forty-eight hours have elapsed from the time of the dispatch of the specimen to the laboratory.

I think it is quite permissible for the pathologist under these circumstances, in order to facilitate early specific treatment in the interests of the patient, which is really all that is required in practice, to suggest a diagnosis on his microscopical findings of the stool alone, and he will, according to my experience, be right in nearly every case; he then can render a finished report at his leisure.

The bilharzia dysentery stool had characteristics of its own—that is, the mucus is of a gelatinous nature and of a yellow colour, containing clots of dark blood in which the characteristic ova are present in large numbers. The pathologist ought to be warned of the clinician's suspicions as to the diagnosis of this condition, as bilharzia ova are searched for under a low-power lens and would certainly be missed with a higher magnification.

I think one must admit that there exists a distinct clinical entity, "lamblia dysentery"—due to the presence, adhering to the intestinal epithelium of the small gut, of large numbers of lamblia.

The stools in the acute stage of this disease consist of green bile-stained tenacious mucus and may sometimes contain a little blood as well. Such patients even in the acute stage are not really seriously ill. None of them appear to be very emaciated, and as the lamblia is an extremely common protozoal commensal parasite among tropical natives, and as these people by long association appear to become tolerant of it, I do not see why the troops in this country should not do the same, and personally I do think that a fetish is now being made of the presence of a few lamblia cysts in an otherwise perfectly normal healthy stool. Why should these entitle a strong, lusty, and apparently healthy man to be permanently invalided when directly he becomes tolerant of the parasite he may be of real service in the field?

Nearly all the vital diagnostic pathological work which I have recounted to you can be done with a very simple apparatus, the use of a few stains, slides and

a travelling microscope. In fact such a portable laboratory can be contained in a small case, such as one which has been my constant companion for years past.

Finally, gentlemen, I hope you will see that in order to satisfy all claims in Egypt one requires to be a clinician, to have a knowledge of tropical medicine, and I am not quite sure, in order to fully appreciate the needs of the Service and one's combatant fellow-officers, to have been a regimental M.O. as well.

Reviews.

SYPHILIS AND THE ARMY. By G. Thibierge, Surgeon to the St. Louis Hospital. Edited by G. F. Marshall, M.D., F.R.C.S. University of London Press. Pp. 210. Price 6s.

The management of venereal diseases amongst the troops of a huge army such as one of those now operating in the present War is a problem which is complicated by many novel factors. Considerations of man-power wastage, for example, make it necessary to strike a right balance between the claims of treatment and military necessities. How far the former must be subordinated to the latter is largely a matter of individual opinion guided by experience, and the book under review is interesting as an exposition of the views of an eminent French syphilologist with regard to the syphilis problem in the French Army. It will be particularly interesting to those who are acquainted with the manner in which the same problem is treated in our own Army.

In common with all who have studied the subject, the author is alarmed at the outlook for his country if syphilis is to continue uncombated by energetic measures. Calculating that the infection of each mobilized soldier or munition worker will mean the loss of one mother of a family and one soldier in the decennial period 1936-45, he estimates that the infections during the War will cost France 400,000 soldiers in that period, or the equivalent of two military classes. His analysis of the sources of infection reveals, as in this country, the important part which is being played by "amateurs" of all classes. He is greatly struck by the number of women infected by their husbands and of lads between 16 and 18 who have contracted syphilis. The prospect outlined by the author is anything but cheerful, but will be useful if it serves its purpose of rousing the country to a true idea of the problem as one of urgent national importance.

Dealing with the diagnosis and treatment of syphilis, the author is mainly concerned with the earlier stages of syphilis, since the tertiary affect the Army very little. For the diagnosis of primary syphilis he lays stress on the importance of microscopic examination and describes the dark-ground illumination as well as a number of staining methods of demonstrating the *Treponema pallidum*. In some instances the instructions are not very precise; one could wish, for instance, for more details regarding the preparation of the ammoniacal solution of silver nitrate used in Fontana's stain and as to the method of dark-ground illumination, particularly as the former is such a popular method of staining and the latter the method of choice for the demonstration of the *Spirocheta pallida*. In describing methods of obtaining the material no mention is made of the very simple technique of gland puncture when the sore has healed or has been treated with antiseptics, though the author mentions the taking of material for sections from the chancre in such difficult cases. Apparently in France, as in this country, the

syphilologist is troubled by the practice of others of relying primarily on the Wassermann test for the diagnosis of primary syphilis, and Dr. Thibierge rightly emphasizes its fallacies in this stage. He has evidently little opinion of the Wassermann test in any stage, however, and one wonders by what method his specimens have been tested to justify such strictures as he employs regarding it.

With regard to the treatment of syphilis, the author evidently subordinates everything to military considerations. The patient is treated with novarsenobenzol, given intravenously in concentrated solution (two cubic centimetres) until lesions have healed. This usually takes about three weeks. Twelve intravenous injections of the cyanide of mercury are given in the same period, and the patient is then discharged to duty with instructions to take mercurial pills for some years. In cases where the soldier's duties permit, the pill treatment is supplemented from time to time by further injections of novarsenobenzol. The author evidently has faith in the soldier continuing his treatment by pills, though in an earlier part of the book he complains of the carelessness of patients with regard to the continuance of treatment after their lesions have healed.

As to administrative details and preventive measures, the author considers that special centres for the treatment are desirable and would place these as near to the soldier's unit as possible. Apparently these hospitals came into use in September, 1916, for non-commissioned ranks but not for officers. Regarding the latter, the author seems to think it would be difficult to carry acceptance of a rule that all officers suffering from venereal disease should be sent to hospital. Definite prophylaxis is recommended, with supervision of women and compulsory treatment of the latter when necessary.

A SYSTEM OF HAND AND FINGER RE-EDUCATION. By Captain C. W. Sewell. London: Baillière, Tindall and Cox. Pp. 6. Price 6s. net.

The re-establishment of the finer movements of the fingers following gun-shot wounds of the upper limb is a subject that is neglected only too frequently. This manual indicates methods by which the necessary digital exercises may be applied, and at the same time secure interest and initiative on the part of the patient. The system consists in the spanning of the "rungs" of a ladder placed at varying intervals apart, tracing different patterns with different fingers, and the building of models with small wooden blocks.

The methods described might with advantage be employed in the later stages of the treatment of injuries involving the ulnar and median nerves, when voluntary movement is returning to the affected muscles, as well as in the various disabilities brought about by disuse.

ELECTRO-THERAPEUTICS FOR MILITARY HOSPITALS. By Wilfred Garton, M.R.C.S., L.R.C.P., Temporary Captain, Royal Army Medical Corps. London: H. K. Lewis and Co., Ltd.

The various disabilities caused by war service have served to draw more attention than formerly to treatment by means of electrical methods. This small volume is intended to serve as a guide for use in smaller military hospitals as well as to obtain further recognition of the value of electrical treatment. The subject of electro-therapeutics, however, is relatively large and one to which it is not possible adequately to do justice within the limits of a small book.

The author furnishes a description of simple apparatus procurable at a small cost, which serves for the treatment of those cases most frequently met with.

In a chapter dealing with the paralysis of muscles, the statement appears that "if the affected muscles contract readily to a faradic current and react normally or almost normally to a galvanic current, then the injury to the nerve is slight and there is probably no structural damage. The condition is similar to a pressure palsy and recovery may be almost immediate and should certainly take

place under three months." No mention is made, however, of hysterical paralyses which are by no means infrequently encountered following gun-shot wounds, and to which the above statement regarding the electrical reactions would equally apply. From the point of view of treatment, the importance of recognizing such conditions cannot be over-estimated, as the longer they are allowed to persist the more difficult is ultimate cure. Further, the writer at times is rather inclined to sacrifice accuracy to brevity, for instance, the observation that "when a nerve is completely divided the faradic current (*sic*) in the muscles supplied by that nerve disappears in a day or two" is scarcely correct.

For ionization, the use of long pads stretching the whole length of the limb is recommended. To state, however, that in neuritis affecting a nerve trunk, "ionization is the only method of treatment worth consideration," is to ignore the most important fact of ascertaining what underlying cause or focus of infection is responsible for the appearance of neuritis, and taking steps to eliminate it.

Good results are claimed for cerebrospinal galvanism in the treatment of patients suffering from "shell shock" and neurasthenia; the manner in which it acts, however, is not suggested. In a later chapter some useful practical hints are given regarding the use of zinc ions for ulcers and sinuses.

THE "NAUHEIM" TREATMENT OF DISEASES OF THE HEART AND CIRCULATION IN ENGLAND. By Leslie Thorne Thorne. Fifth Edition, 1918. Pp. vi + 160, $7\frac{1}{2} \times 4\frac{1}{2}$. Published by Baillière, Tindall and Cox.

The reviewer happens to have studied this method of treatment in Nauheim. He can, without adverse racial prejudice, testify to the fact that, as expounded and practised by Dr. Thorne, the "Nauheim treatment" can be carried out in the British Isles in every detail, and not less efficaciously, than in the town which gives it its name. In this connexion, doctors have only to be careful to recognize that much of the benefit of Nauheim itself is attributable to its healthy situation and to its distance from the sources of worry and strain for British visitors.

In this little book, Dr. Thorne proves convincingly that he has completely mastered this important method of treatment. He honestly and unselfishly gives abundant help to such of his professional brethren as may be undertaking the practice of his methods. Full details are invariably given, and many little "tips" that can only have been culled from very wide experience in the practical application of the treatment and the selection of suitable cases. The exemplary cases that are given as brilliant little clinical pictures speak for themselves. It is very pleasing to see that Dr. Thorne gives his readers the opportunity of interpreting his cardiograph tracings independently in that he shows most of them from their commencement, and not, as has become a misleading fashion, a small section carefully selected and lettered to suit a particular purpose. It is to be regretted that the chapter given to the controversial subject of "Soldier's Heart" is so slender, considering its importance. However, as in all the chapters, some excellent practical points are emphasized, e.g., the importance of avoiding too long rest for the heart's sake alone. Insufficient stress is laid upon the mental factor in "Soldier's Heart": on the other hand, the author evidently believes that sinus arrhythmia plays an important rôle in this symptom-complex, for he seems to have found it more marked and more constant than have others of wide experience.

No practical physician who wishes to keep conversant with modern cardiology can afford to leave this book unread, even in these pressing times. R. T. S.

Journal
of the
Royal Army Medical Corps.

Original Communications.

ON THE PATHOLOGY AND TREATMENT OF POISONING BY
TRINITROTOLUENE ("T.N.T."), AND ON THE ACTION
OF CERTAIN OTHER POISONS WHICH AFFECT FAT
METABOLISM.

BY MAJOR ALEXANDER G. R. FOULERTON.

Royal Army Medical Corps (T.F.).

*Officer in Charge of the Hygiene Department, Royal Army Medical College; Lecturer
on Public Health to the London School of Medicine for Women, and in the Hygiene
Department of University College, London; County Medical Officer of Health for
East Sussex.*

(From the Hygiene Department, Royal Army Medical College.)

CERTAIN obvious clinical and pathological features of cases of poisoning by trinitrotoluene, or trotyl, suggest at once their inclusion in a group to which may be referred also, (1) the cases of poisoning which occurred formerly amongst workers with tetrachlorethane in aircraft factories and cases of poisoning by dinitrobenzene ("D.N.B.") amongst munition workers, (2) cases of "delayed" chloroform and ether poisoning, after the administration of either for anæsthetic purposes, and (3) cases of acute phosphorus poisoning.

In all these cases there may be an acute manifestation of jaundice, sometimes with concomitant glycosuria, or acetonuria, as indications of disorder of metabolism. In all there may be found after death either fatty changes in the liver with some enlargement of the gland, or fatty changes in association with disorganization of the parenchyma cells, extensive interstitial fibrosis, and shrinkage of the gland as a whole. It has been presumed commonly that the two sets of changes represent earlier and later stages of a continuous pathological process.

Fatty changes have been described as occurring in the kidneys also,

more particularly in "delayed" chloroform poisoning, and in poisonings by tetrachlorethane, by dinitrobenzene, and by trinitrotoluene. An intense fatty engorgement of the liver, with some fatty engorgement of the kidneys, was found in the one case of "delayed" ether poisoning which the writer has had the opportunity of examining. "Fatty degeneration" of the heart muscle has been described, usually somewhat indefinitely, as occurring in some of these cases.

It is possible that yet another class of cases of poisoning, ~~chronic~~ arsenical poisoning, belong properly to this group. "Toxic jaundice" has occurred amongst industrial workers who are liable to inhale arseniuretted hydrogen. Similar jaundice has been recorded as occurring amongst French and German balloonists, as the result of inhaling hydrogen mixed with arseniuretted hydrogen. It has been assumed that the jaundice that occurs in these cases is hæmatogenous; but apparently there is not any available account of the exact changes found after death. It is known that fatty changes are of common occurrence in the liver in arsenical poisoning caused in other ways. Poisoning by arseno-benzene compounds comes perhaps within a category somewhat different from that of poisoning by mineral arsenical salts. It would appear that the toxic effects of certain organic arsenic compounds may be influenced materially by the benzene constituent. Experimental work in connexion with the special toxicity of arseno-benzene compounds has been in progress in the Hygiene Department of the College for some time past; and the results obtained so far appear to bring these compounds into close relation with the class of poisons now being considered.

It has been supposed generally in cases of poisoning by the group of six substances more particularly referred to that the essential cause of disease is a primary disorder of the liver; the fatty changes in the liver and kidneys have been described as resulting from a fatty degeneration of the parenchyma cells of these glands. A consideration of the pathological conditions occurring in poisoning in man and in laboratory poisoning of animals suggests an alternative explanation. It would appear to be probable that the pathological disturbance in poisoning by trinitrotoluene in particular, and also in poisoning by the five other substances mentioned, is in the first instance a disorder of fat metabolism caused by the absorption of poisons which have a special affinity for fats, with a consequent condition of abnormal lipæmia. The fatty changes in the liver and kidneys are not the results of a fatty degeneration of the cells of these glands; they represent rather a fatty infiltration, or engorgement, of the organs with fat brought to them from elsewhere. The fat in the liver represents fat brought to the liver, probably in abnormally large quantities in some cases, for purposes of normal metabolism, but which, because of functional failure of the liver, cannot be dealt with in the normal way. The fat found in the kidneys represents excessive fat in process of elimination from the blood. It appears further that the failure of the liver with respect to

its normal activity in the metabolism of fat is not caused only by overstrain of its physiological capability, but is due also to a direct action of the poison on the parenchyma cells of the gland. There is not only an excessive accumulation of fat in the liver, there is also a concentration of the poison there, brought to the liver in combination with the fat. So with the kidneys. Not only is the kidney engorged with circulating fat in process of elimination, but the cells of the gland are exposed to the action of a concentration of the poison carried there with the fat.

THE NORMAL PROCESS OF FAT METABOLISM.

Before considering in detail the nature of the disorder of fat metabolism in poisoning by trinitrotoluene it will be useful to set out briefly the general bearing of modern teaching as to the normal metabolism of fats. Fats occur in the body in three conditions: (1) as *circulating food fat* which is taken up from the intestines by the lacteals, collected in the thoracic duct, discharged from the thoracic duct into the general circulation, and subsequently altered in the liver in such a way as to be made available by various tissues and organs as a source of vital energy, (2) as *reserve fat* which, stored up in the connective tissues, represents any amount of fat ingested which is in excess of the daily need of the body, and (3) as what may be termed, in want of a better description, *available organic fat*. Available organic fat may be defined as fat, either abstracted directly from the circulating food fat or withdrawn from the reserve fat of the connective tissues, which has been rendered by the action of the liver available for the production of energy by the active tissues and organs of the body. The researches of Leathes and others have shown that the circulating food fat and the reserve fat of the connective tissues are of identical constitution, and may be recognized in the body by their low iodine value: in other words these fats contain a high percentage of saturated fatty acids. On the other hand, the available organic fats found in active organs, and in the liver in particular, have a high iodine value—their percentage content of saturated fatty acids is low. Leathes has proved further that when the reserve fat of the connective tissue is set free, or mobilized, either to meet physiological requirements or under certain conditions of disease, it is carried to the liver and is there transformed into what I have termed “available organic fat.” The change effected in the liver appears to include a desaturation of the acids of the reserve fat and, probably, an elaboration of compounds of nitrogen and phosphorus with the desaturated acids. Also it is probable that so much of the circulating food fat as is required for the ordinary daily work of the body is transformed in the liver in a similar way.

Leathes has applied the results of his investigations to an explanation of the fatty changes that are found in the liver in some chronic diseases and in chloroform and phosphorus poisonings. He states the matter thus: “Too active a mobilization of stored fats, or too little activity in

dealing with them on the part of the liver, will result in an accumulation of the unfinished product in the organ. A fatty liver is the result, and the fatty acids which it contains are found to have a low iodine value." The fatty liver which occurs under the conditions is, then, a liver engorged with reserve fats, and probably circulating food fat also, which, for one reason or another, are not being transformed into available organic fat, as would happen in the normal process of metabolism. Another probable function of the liver in connexion with fat metabolism—the synthesis of fat from butyric acid derived from surplus carbohydrate food—does not appear to require consideration in connexion with the present purpose.

MICROSCOPICAL CHANGES FOUND IN FATAL CASES OF POISONING BY TRINITROTOLUENE.

In the course of the discussion at the Royal Society of Medicine, in March, 1917, on the causation, symptoms, pathology, etc., of "toxic jaundice" occurring amongst munition workers, the histological and other microscopical changes found in some of the organs in twenty-five cases of fatal poisoning by trinitrotoluene were referred to specially. Captain M. J. Stewart, R.A.M.C., described degenerative and cirrhotic changes in the liver in seven cases, and stated that "the amount of fatty changes varies considerably, but is never extreme." A brownish pigment, resulting—it was believed—from disintegration of the liver cells, was present generally; hæmosiderin could be demonstrated in the liver in one of the cases only. In the kidneys, "a very extreme degree of fatty degeneration is usually, but not invariably, present." Dr. Bernard Spilsbury, referring to the histological changes which he had found in poisoning by tetrachlorethane (5 cases), dinitrobenzene (1 case), and trinitrotoluene (7 cases), stated that "the effects of these three poisons are comparable in that the most marked changes are found in the liver, these consisting essentially in a fatty degeneration of the liver cells, followed by necrosis and disintegration of all the cells in large areas. These poisons also produce a varying degree of fatty degeneration in the kidneys and generally in the heart muscle."

Spilsbury found fatty changes in both liver and kidneys in all of the cases of poisoning by trinitrotoluene, and in the liver in four out of five cases of poisoning by tetrachlorethane. In the single case of poisoning by dinitrobenzene there was a coarse, irregular, cirrhotic change in the liver, and fatty degeneration was not found either in the liver or in the kidneys. Dr. H. M. Turnbull gave a very careful account of certain changes found in 11 cases of fatal poisoning by trinitrotoluene, including 7 cases (group 1) in which death was "apparently due to hepatic insufficiency," and in which severe jaundice had been associated with an extensive destruction of the liver found after death; 1 case (group 2) in which there had been multiple cutaneous hæmorrhages and slight general jaundice; and 3 cases

(group 3) in which there had been severe anæmia, without any jaundice. Turnbull stated, with reference to the first group of cases, that "the lesion in the liver may be described in general as a degeneration and necrosis of parenchyma associated with infiltration and fibrosis," that in areas of the liver in which the destruction of the parenchyma was least marked the necrosis of the cells was preceded by a fatty degeneration, and that "in areas of complete destruction of parenchyma—degenerate and necrosed, fatty, hepatic cells give place to fat granule cells." Hæmosiderin could not be demonstrated in the sections of the livers. Fatty degeneration of the cells of the kidney is described in six out of the seven cases in which this gland had been examined. The pancreas was examined in five cases, and fatty granules were found in sections of three of them. In the single case of group 2 a few "necrosed fatty cells" were found in the liver, which presented an extensive fibrotic change of the interstitial connective tissue, and there was "slight fatty degeneration of the epithelium of the second convoluted tubules and in a very few cells of the ascending limbs of Henle" in the kidneys. In two of the three cases of severe anæmia—two of which are described as cases of "aplastic, hæmolytic anæmia"—in which there was not any jaundice, a greater or less degree of "fatty degeneration" of the liver and kidney parenchyma cells is described, and there is not any description of the microscopical examination of these glands in the third case. Hæmosiderin was found in the liver in two of the cases, but does not appear to have been present in the third. Throughout the discussion at the Royal Society of Medicine, the fatty changes found in the liver and kidneys in cases of poisoning by trinitrotoluene were spoken of exclusively as representing a secondary fatty degeneration of the parenchyma cells of the glands. My own investigations suggest that, as stated above, the fatty changes in these glands result from an engorgement with fat brought to them from elsewhere.

By the courtesy of Miss Margaret Fraser, M.B., B.S., Physician to the South London Hospital for Women, I have had the opportunity of examining the liver, kidneys, and certain other organs from three fatal cases of poisoning by trinitrotoluene poisoning which were under her care in the hospital. The main clinical facts relevant to my present purpose are as follow:—

Case 1, a married woman aged 23, left work on January 18, and was admitted into hospital with jaundice on January 25. The patient became unconscious on January 26, and died on January 28.

Case 2, a married woman aged 50, left work on January 17, and was admitted into hospital on January 24 with jaundice: she became unconscious, and died on February 2.

Case 3, a single woman aged 18, left work, being then apparently in good health, on December 22. Symptoms of jaundice appeared on December 23, and the patient was admitted into hospital on December 29. The condition of the patient improved slowly, and she improved suffi-

ciently to be allowed up. At first her blood presented a normal cytological condition, the red cell count being somewhat above the normal average, and the hæmoglobin index normal. A condition of rapidly increasing anæmia became apparent later; the red cell count fell away rapidly, and the patient died with aplastic anæmia of an extremely severe type on April 18 of the following year.

It was not possible to make a complete histological examination in any one of these cases, but the following material was examined: in Case 1, the liver, kidneys and lung; in Case 2 the liver, kidneys and heart; and in Case 3, the liver, kidneys, lungs and pancreas.

The special method of fat-staining followed in the examination of sections of this material, as also in the examination of the tissues of the experimental animals, was a rapid Herxheimer method. The fresh tissues were frozen and cut. After washing in water the sections were stained, for from one to two minutes, in a mixture of equal parts of acetone and of a saturated solution of scharlach R. in seventy per cent alcohol. The sections were then washed in water, stained for one minute in the strong Mann's acid hæmatoxylin solution, washed in tap water until blued, washed in acid alcohol, washed again in tap water, and mounted in glycerine-gelatine jelly.

The changes found in the three cases respectively were as follow:—

Case 1.—The examination of sections of the liver showed advanced degeneration and disintegration of the parenchyma cells, with complete structural disorganization of the gland; a very large quantity of lightish brown granular material was scattered in small masses throughout the liver, some of the masses gave the reaction for hæmosiderin and others did not. A few collections of largish fat globules were found in some of the sections; but most of the sections were free from any trace of fat. The kidney sections showed a cloudy degeneration of the epithelium of the tubules generally, where the structure was not masked by the accumulation of fat. The straight portions of the tubules in the medullary zone contained a good deal of brownish material, varying in colour from a deep to a light greenish brown. The convoluted and straight portions of the tubules showed thickly numerous granules of fat, both in and outside the epithelial cells. To the naked eye the lungs appeared to be in a condition of solid œdema. Microscopically, there was marked cellular infiltration of the connective tissue stroma of the lungs, without any marked exudation into the alveolar spaces. Scattered through the interalveolar tissues there were numerous fat granules, some lying apparently free in the tissues, others contained in largish mononuclear cells. Small masses of brownish material occurred here and there in the interalveolar tissue.

Case 2.—Sections through the liver showed advanced interlobular round-celled infiltration and fibrosis, with marked degeneration of the parenchyma cells generally. There was a large amount of fat, distributed in globules of various size, partly in the interlobular round-celled and

fibrotic tissue, and partly lying either in or between the parenchyma cells, especially about the periphery of the lobules. Numerous small masses of brownish pigmented material were scattered throughout the liver, only a relatively small proportion of which stained as hæmosiderin. A large quantity of fat was present in the kidney. As in Case 1, the fat was confined to the convoluted and straight portions of the tubules in the cortical zone, where globules of fat could be seen lying between the tubules, in the epithelial cells, and a little in the lumen of the tubules. As in Case 1 also, the glomeruli were free from any traces of fat. Here and there a tubule contained dark brownish or greenish brown material. The heart muscle showed the appearances commonly associated with "pigmentary degeneration," or brown atrophy; but there was not any abnormal fat in the sections stained with scharlach R.

Case 3.—The parenchyma cells of the liver were mostly in a stage of advanced degeneration. There was a good deal of accumulated fat, especially about the central zone of the lobules; the exact relation of the fat to the remains of the parenchyma cells could not be determined. A large quantity of lightish brown material, none of which gave a hæmosiderin reaction, was scattered throughout the sections. The kidney section showed an advanced degenerative change of a hyaline appearance throughout the tubules. No fat in connexion with the tubules themselves could be demonstrated with the stain, but a very few minute fat globules could be seen lying either in or between the cells of the glomeruli. Some of the tubules contained casts of a reddish-brown homogeneous material. The sections of the lungs were of normal appearance, and did not show any fat. The pancreas showed an extensive fibrosis of the interstitial tissue, with advanced degeneration of the parenchyma cells, which could not be differentiated individually. In sections stained with scharlach R. the widely isolated lobules appeared as islands of pigmented, and more or less disintegrated, material lying in a fibrotic mass, and full of globules of fat of various sizes.

THE INTERPRETATION OF THE SIGNIFICANCE OF THE FATTY CHANGES FOUND IN "TOXIC JAUNDICE."

Experiments carried out some years ago in connexion with the action of poisonous doses of ether and chloroform on the rabbit suggested that the fatty changes appearing in the liver could not represent a primary fatty degeneration of the parenchyma cells of the gland. Under the experimental conditions in the lower animals, and equally in cases of delayed chloroform poisoning in man, the accumulation of fat is greater in amount, and more rapid, than could be accounted for in this way. And Leathes' hypothesis, applied to cases of phosphorus and chloroform poisoning in man, appears to supply satisfactory alternative explanations. The fatty changes in these cases do not represent any degenerative change in the parenchyma cells themselves, but result from infiltration of the liver with

fat carried to the gland from elsewhere. And the accumulation is either because there is an abnormal liberation of the stored connective tissue fat, or because the functional activity of the liver is so impaired that the gland cannot deal with the ordinary food-fat. Or, as appears to be the case in poisoning by trinitrotoluene and some other substances, the two factors are working together—there is an abnormal mobilization of the stored fat, and the functional activity of the liver is impaired by the direct action of the poison on the parenchyma cells with consequent degeneration, but not of a fatty kind. Considering the condition found in man in poisoning by trinitrotoluene, it does not appear that there is any correlation between the degree of fatty change in the liver and kidneys and the degree of actual degeneration of the cells of these glands. In Case 1 there was advanced degeneration of the liver parenchyma cells with very little fatty change. The kidney was engorged with fat, but there was not any marked alteration of the epithelium in the medullary portion of the kidney, where the structure of the cells could be seen clearly without the complication of the picture caused by fat engorgement. In this case it may be supposed that the liver had become functionless, in the matter of fat metabolism, whilst the fat taken with food was being eliminated, probably unchanged, by kidneys which were still moderately effective functionally. In Case 2, an abnormal lipæmia was indicated by the presence of fat in the interstitial tissue of the lungs, the parenchyma cells of the liver were less completely destroyed, and a certain amount of fat was still collecting in the liver, and apparently was being passed—imperfectly—through the cells of the lobules from the periphery towards the central vein. Meanwhile the excess of food-fat was being eliminated, as in Case 1, by the kidneys. The circumstances of Case 3 appear to be altogether different. In this case the patient had recovered, it may be assumed, from the direct action of the trinitrotoluene; she died of sequelæ to the acute poisoning, the principal cause of death being an aplastic anæmia, due to destruction of the bone-marrow at an earlier stage of her illness. The liver cells had undergone extensive degeneration, but the gland still held a moderate amount of fat. The absence of fat from the kidneys was remarkable in this case; possibly the amount of absorbed food-fat had been reduced to very low proportion in consequence of destruction of the activity of the pancreas which, judging by the extent of the fibrotic change and the degeneration of the parenchyma cells, must have been nearly or quite functionless. It was noticeable, also, that together with an absolute absence of fat from the tubules of the kidney there was a far-advanced degeneration of the renal epithelium. The biological mechanism of the degeneration of the pancreas, which has been observed in other cases of poisoning by trinitrotoluene, cannot be explained at present.

EXPERIMENTAL POISONING WITH TRINITROTOLUENE: CATS
AND RABBITS.

The findings in the three cases referred to, together with a consideration of the pathological changes described by others, would appear to justify the assumption that there is a degeneration of the parenchyma cells of the liver, and in certain cases of the kidneys also, caused by the direct action of the poison. The degeneration thus caused is not a "fatty degeneration." When the degeneration of the liver cells has reached a certain point, a natural sequence will be, in accordance with what has been pointed out with regard to the normal fat metabolism, the establishment of an abnormal lipæmia caused by an excess of circulating food fat. Beyond all this there is, however, the question as to whether there is not in poisoning by trinitrotoluene and the other poisons under consideration a further disturbance of fat metabolism, resulting from a freeing, or mobilization, of the reserve fat of the connective tissues, whereby the condition of lipæmia is intensified.

In an attempt to clear up this point, the action of trinitrotoluene, administered by the mouth by subcutaneous injection and by inunction into the skin, has been tested on the cat and the rabbit. Because of circumstances the number of experiments has been limited, but the results obtained appear to be closely relevant to the question.

Cat I., weighing 4,750 grammes, was poisoned rapidly with trinitrotoluene administered by the mouth, 0.75 gramme being taken with food at 3 p.m., and 0.5 gramme exactly twenty-four hours afterwards. The animal did not show any signs of poisoning after the first dose; but at 10 a.m. on the third day, nineteen hours after the second dose, it was found crouched up in its cage in a semi-comatose condition. It became deeply comatose about an hour later, lying extended on its side. There were occasional convulsions, and the animal died at 4 p.m., forty-nine hours after the administration of the first dose. Examination after death: The body weighed 4,350 grammes, and all the organs were of natural appearance. The animal had not passed any urine during the last day; the bladder contained about 0.5 cubic centimetre of turbid, almost black, highly concentrated urine, which had a very disagreeable odour. With Webster's test the urine gave a characteristic reaction for trinitrotoluene in organic combination. Sections of the liver, kidneys, and spleen were stained for microscopic examination. The liver showed a slight, but quite definite, degree of interlobular round-celled infiltration. The parenchyma cells appeared to be of a brownish colour, and did not take the hæmatoxylin stain well. A few globules of fat, stained by scharlach R., were scattered through the sections, some lying within the lobules, and some in the areas of interlobular round-celled infiltration; some of the fat was contained within cells, some was apparently free. There were not any pigment masses in the gland. The cortical portion of the kidneys was

heavily engorged with fat, so that sections stained with scharlach R. presented a bright red cortical zone when looked at with the naked eye. On microscopic examination it was found that the Malpighian capsules were free from fat, but the rest of the cortical portion of the kidney was so crowded with largish globules of fat that the relations of the fat and the tubular epithelium could not be defined. The straight tubes in the medullary portion of the gland contained some brownish material which did not stain as hæmosiderin. In sections which included the area of the pelvis of the kidney, some globules of free fat could be seen; this fat, however, might have been displaced from the cortical zone in making the sections. The spleen was of normal appearance, the pulp stained well with hæmatoxylin, and neither fat nor abnormal pigment were there. The symptoms in the case and the apparent blockage of the kidney tubules with fat suggested uræmia as the immediate cause of death.

Cat II., weighing 3,750 grammes, was given occasional doses of trinitrotoluene, 0·5 gramme every third or fourth day, mixed with lean meat or fish, for a period of about three weeks. Very little of the poison, however, was actually taken; after swallowing a mouthful or two of the food, an attack of sneezing would come on, followed by salivation, and unmixed food had to be given. The exact amount of trinitrotoluene ingested could not be estimated, but at the end of the three weeks the animal appeared to be in perfect health, and had not lost any weight. Attempts to administer the trinitrotoluene by the mouth were stopped, and the cat was put on a diet of lean meat. The skin of the right flank was then shaved over an area of about fifteen square inches and one gramme of trinitrotoluene, mixed with vaseline, was rubbed thoroughly into the shaven skin on each of three consecutive days. Three more doses were rubbed into the skin with two-day intervals, so that six doses of one gramme each were applied during a period of twelve days. On the thirteenth day the animal was very drowsy, would not take its food, and appeared to be moribund. Its condition improved on the following day, and on the fifteenth day it had apparently recovered, and was taking its food well. Another dose of one gramme was applied during the afternoon, and the animal was found to be in a drowsy condition two hours afterwards. On the following day the drowsiness had passed off—the animal was taking its food, and another dose of one gramme was rubbed in. On the next day, the seventeenth day after the commencement of inunction, there was extreme drowsiness, and the hind limbs were paralysed; a dose of 1·5 gramme was applied. The animal died on the eighteenth night after the commencement of the inunctions, and after 9·5 grammes had been thus administered. Examination after death: The body was much emaciated, weighing only 1,150 grammes. The organs were of natural appearance, except that the liver appeared to be rather deeply congested. The bladder was distended with urine, which was of acid reaction and of a dark brown colour. At first the urine appeared to be quite clear, but, on standing, a mucus-like

sediment began to separate out. On centrifugalizing the urine, a somewhat dense sediment of mucus was obtained, in which were entangled a very large number of globules of fat, which measured from about 0.5 micron to twenty microns, and which stained in a typical way with scharlach R. A strong reaction was obtained with Webster's test for trinitrotoluene in organic combination. The nature of the dark brown pigment in the urine was not determined; so far as could be decided by chemical and spectroscopic examination, it was not a hæmoglobin derivative. The microscopic examination of the skin will be referred to later on. Sections of the liver showed a well-marked round-celled infiltration of the stroma, with degeneration of the parenchyma cells, many of which, however, still stained well with hæmatoxylin. There was a large quantity of dark brownish material infiltrating the lobules, and collected especially round the central vein, which in some instances appeared to be plugged with the material. The cortical zone of the kidneys contained an enormous quantity of fat in small granules or globules, which appeared to be situated both in and between the epithelial cells of the tubules. Granules of brownish material were present either in, or on, the epithelium of the Malpighian capsules, which were free from fat. Brown pigmented material could be seen in the straight tubules of the medullary portion. A quantity of brown pigment was distributed throughout the lungs, between the air vesicles; in some places small vessels, seen in transverse section, were apparently plugged with this material. Sections through the heart muscle showed a brown pigment distributed between the muscle fibres and in places apparently in the capillaries. The spleen pulp was heavily loaded with brown pigmented material, which, however, was present very scantily in the Malpighian bodies. None of the pigment in the liver, kidney, or spleen stained as hæmosiderin.

Cat III, weighing about 3,500 grammes, was fed for seventeen days with occasional doses of 0.5 gramme of trinitrotoluene mixed with various foods—lean meat, fish, cream and margarine. But difficulties similar to those which prevented the carrying out of feeding experiments with *Cat II* occurred. After a small quantity of food had been taken, fits of sneezing, followed by salivation, came on, and at each meal unmixed food had to be substituted after quite a small quantity of trinitrotoluene had been ingested. The cat remained apparently in good health, and had not lost weight when it was killed, eighteen days after the commencement of the experiment. Examination after death: All the organs were of natural appearance. The bladder was empty of urine. The liver showed commencing round-celled infiltration of the stroma, the parenchyma cells stained rather badly with hæmatoxylin, and there were a certain number of fine globules of fat scattered sparsely through the sections. Sections through the kidneys showed a moderate amount of fat in the cortical zone. The epithelial cells of the tubules in the cortical zone were of normal appearance and in places were stained a diffuse pinkish colour by scharlach R., the bright red-

stained globules of fat, mostly in the part of the cell remote from the lumen of the tubule, standing out in sharp contrast. There was a considerable quantity of brown homogeneous material in the tubules, especially in the convoluted portions, and a little amongst the epithelium of the capsules of the glomeruli. The vessels of the kidney were overdistended with blood, and blood cells in addition to the homogeneous brown material were present in the tubules and in the Malpighian capsules in places. Sections of the spleen showed a considerable quantity of brown pigment scattered through the pulp, the Malpighian bodies here and there showing largish masses of it.

Rabbit I, weighing 2,260 grammes, was fed by means of an œsophageal tube with considerable quantities of trinitrotoluene; altogether 8·4 grammes were given, in twenty-one doses varying from 0·25 to 0·6 gramme, during a period of thirty days. The animal remained in good health and took its food well throughout the period; it lost weight at first, but at the end of the experiment weighed the same as at the commencement. On the day after the feeding with trinitrotoluene was stopped, a small area of the skin was shaved, and 2 grammes of trinitrotoluene, mixed with vaseline, were rubbed in. On the next day the animal was very drowsy, and did not take its food, but had quite recovered on the day following. On each of the next two days a dose of 1·75 gramme was rubbed into the skin. The animal became drowsy again after the last inunction, and was killed on the following day. Examination after death: All of the organs appeared to be healthy. The bladder contained a small quantity of acid urine of a dark coffee-brown colour. A considerable sediment, consisting mainly of long renal casts of homogeneous dark-brown material, was thrown down on centrifugalization of the urine. Sections through the liver showed a quantity of fat, especially in the zone round the central vein of the lobules. The parenchyma cells of the gland were apparently but little affected. There were indications of commencing round-celled infiltration of the interstitial tissue. The epithelial cells of the kidney tubules appeared to be swollen and in many places in the cortical zone appeared of a brown tinge. Many of the tubules were filled with homogeneous dark brown material; small masses of similar material were present on the capsule of the glomeruli here and there. No fatty change was apparent. Blood cells were seen in some of the tubules. The spleen was loaded with fine and coarse granules of brown pigment. Sections of the lungs showed a number of cells containing minute fat granules in the interalveolar tissue which appeared to be increased in bulk, or œdematous. The pigmented material in the spleen and kidneys did not stain as hæmosiderin.

Rabbit II, weighing 2,050 grammes, was injected with a suspension of trinitrotoluene in normal saline solution, thirteen doses varying from 0·1 to 0·45 gramme being given subcutaneously during a period of twenty-two days. Because of the rapid separating out of the suspension in normal saline solution the exact dosage was difficult to determine, but it was

estimated that about 4.75 grammes, possibly a little less, were administered by the thirteen injections. The animal remained apparently quite well throughout the experiment, except that sometimes it became drowsy after an injection. It took its food well and put on weight at first, to the amount of 200 grammes by the end of the first eight days. After then the weight gained was lost gradually, but just before the animal was killed, on the day after the last injection, the weight, 2,100 grammes, was a little more than the weight at the commencement of the experiment. Examination after death: The body was kept in cold storage for a few hours before it was examined. All the organs were of natural appearance externally. On cutting the kidneys open, it was found that the pelvis of each gland was filled with a solid plug of fat (*see illustration*). The bladder contained a large quantity of clear acid urine of a dark coffee-brown colour. On extracting the urine with ether, the ethereal extract was of a light reddish brown colour, and did not give the reaction for trinitrotoluene with



Webster's test. The urine residue was then acidified with sulphuric acid, and extracted with ether. The second ether extract was of a light yellow colour, and gave an intense reaction with Webster's test. Sections of the liver showed a small amount of interlobular round-celled infiltration, with small globules of fat in the interstitial tissue here and there. The parenchyma cells stained well with hæmatoxylin, and did not show any marked changes. There was not any fat within the lobules, it being present only amongst the cells of the infiltration occurring along the course of the interlobular portal circulation. A few small collections of pigmented matter were seen in some of the sections. The cells of the cortical zone portions of the kidney tubules were stained a pinkish colour by scharlach R., and a certain quantity of fat globules, stained typically, were present. Sections through the gland showed a solid plug of fat free in the pelvis of the kidney. The spleen was loaded heavily with dark brown pigment, which did not stain as hæmosiderin. The sections through the lungs showed normal appearances, excepting that there were small collections of brownish pigment here and there.

For control purposes, in connexion with the animal experiments, a series of sections through the lung, liver, kidney, and spleen of a healthy cat and of two healthy rabbits were cut and stained with scharlach R. under conditions exactly similar to those under which the sections from the organs of the experimental animals were prepared for examination. In the liver of the normal cat a few isolated large globules of fat, and a few small collections of small globules, were scattered at considerable distances apart through the sections. In sections through the kidneys, a good deal of the epithelium of the portions of the tubules within the cortical zone was stained a diffused light pinkish colour, and small droplets of red-stained fat could be seen in the epithelial cells, but in small numbers and widely separated. It is well known that fat occurs, sometimes in noticeable quantities, in the kidney of the healthy cat; but there could not be any comparison between the presence of the comparatively small amount of fat in the gland of the normal animal and the heavy flooding of the kidneys of the experimental animals with fat. There was not any fat in the lungs of the healthy cat, except a little in the connective tissue immediately around some of the larger bronchioles; nor was any deposit of pigment found in any of the organs examined. Neither fat nor pigment could be found by means of the method employed in any of the organs from the two normal rabbits that were examined.

EFFECT OF POISONING BY TRINITROTOLUENE AND CERTAIN OTHER SUBSTANCES AS REGARDS FAT METABOLISM.

With respect to their special affinities for fats the six poisons under consideration may be divided, somewhat artificially, into two classes. Three—tetrachlorethane, chloroform and ether—are active solvents of fats; the other three—trinitrotoluene, dinitrobenzene, and phosphorus—are readily soluble in fats. An excess in the blood of one of the first class of poisons, following inhalation of the vapour, will probably act directly on the stored fat of the connective tissues, with the production of an excessive lipæmia—excessive in the sense that the mobilization of reserve fat is not in response to a physiological requirement. The liberated fat will accumulate in the liver, its natural destination for the purpose of being converted into “available organic fat” carrying with it the substance which has liberated it. More of the poison will be brought to the liver with the circulating food fat. The assumption that the fixed fat of the connective tissues, as well as the circulating food fat, may be affected by the presence of, for instance, chloroform which has been taken up by the blood, is founded on the relatively rapid accumulation of fat in the liver and kidneys in the experimental poisoning of rabbits with chloroform. The engorgement with fat is sometimes so intense that it is difficult to believe that all the fat present could be provided, within a few days, by the ordinary diet of laboratory animals. When trinitrotoluene which has

been fixed in the skin is taken up, in one way or another, by the blood it appears to be probable that there is a similar process, connective tissue fat and circulating food fat being affected alike. When poisons of the second class—trinitrotoluene and phosphorus more especially—are swallowed, their special affinity for fats will cause concentration of them also in the liver. The poison will be dissolved in the fatty constituents of the intestinal contents, will be taken up with the fats by the lacteals, and will be carried directly to the liver with the circulating food fats. The picture of poisoning in all these cases represents, therefore, combination of the poison with fat, abnormal liberation of fixed connective tissue fat, concentration in the liver of the poison in combination with the fat, impairment of the fat-metabolizing and other functions of the liver, an excessive accumulation of fat in the blood, and engorgement of the kidney with that fat in process of elimination from the blood. And so the excretory cells of the tubules of the kidney, as the parenchyma cells of the liver, are subject to the effect of a concentration of the poison carried to them with the excess fat in the blood. One effect of the fixation of trinitrotoluene in the fat of the connective tissue is illustrated conspicuously by the aplastic anæmia which occurs occasionally amongst the special class of munition workers affected, as an effect of the action of the concentrated poison on the hæmatogenic cells of the bone marrow.¹ Evidence of an excessive lipæmia was furnished by the presence of fat in the interalveolar connective tissue of the lungs in one of the cases of human poisoning, and in one of the two experimental rabbits. Similar evidence was furnished by the finding of fat in the areas of round-celled infiltration of the liver, in addition to the fat occurring within the lobules. The fact of elimination of fat by the kidneys, under the conditions of experimental poisoning, was proved by the finding of large quantities of fat in the urine of one of the experimental cats, and by the solid plugs of fat found in the pelvis of each kidney in the case of one of the experimental rabbits. In these cases, then, there are two main pathological processes to be taken into account, the effect of the poison on fat-metabolism, and the direct action of the poison on various organs—the liver and kidneys more particularly. And, it may be repeated, the degenerative changes produced in the parenchyma cells of these organs by the direct action of the poison are not of the nature of a fatty degeneration.

In certain other experiments carried out in the Department in which

¹ The fact that the obvious destruction of red cells which occurs in poisoning by trinitrotoluene does not cause any marked secondary anæmia, in the majority of cases, is of interest in connexion with the special affinity of the poison for fat. It is suggested that the fixation of a certain moderate amount of trinitrotoluene in the bone marrow causes a stimulation effect, with an increased output of red cells which compensates for their destruction. In comparatively rare cases the action of the trinitrotoluene goes beyond the point of stimulation, destruction of the bone marrow as a cell-producing centre results, and aplastic anæmia follows.

rabbits have been poisoned with arseno-benzene compounds, which closely resemble trinitrotoluene in some of their pathological effects, it has been found that the first appearance of fat in the liver is not in the parenchyma cells, but in the areas of interlobular round-celled infiltration which appear along the course of the portal circulation. In such cases there may also be evidence of elimination of fat by the kidneys.

THE ORIGIN OF THE PIGMENTS FOUND IN THE URINE AND IN INTERNAL ORGANS IN POISONING BY TRINITROTOLUENE.

The question of the origin of the pigments occurring in the urine and distributed through the liver, kidneys, spleen, lungs, and other organs in poisoning by trinitrotoluene—whether in human cases or in the experimental poisoning of lower animals—is complicated by the fact that two different kinds of organic pigment at least, and probably three, have to be considered and differentiated. In the first place there is, undoubtedly, a residual blood pigment produced by the action of the poison on the hæmoglobin of the blood cells, the first stage in the production of the pigment being marked by the presence of methæmoglobin in the blood, and a later stage by the presence of hæmosiderin in the liver and spleen. Secondly, there are the bile-pigments, manifested by the jaundice of human cases. And for the third kind of pigment, it appears from observations made in the course of my investigation that a brownish benzene derivative pigment is produced in the body in poisoning by trinitrotoluene. It appears to be probable also that a similar pigment is produced in certain cases of poisoning by arseno-benzene compounds—cases which present otherwise a remarkable resemblance in essential respects to cases of poisoning by the benzene derivative, trinitrotoluene. It can only be suggested now that this organic pigment may be related to that produced in the urine in cases of phenol poisoning by the oxidation of hydroquinone or p-dioxybenzene.

The direct action of trinitrotoluene on the red blood cells was studied by microscopic methods in connexion with sections made across the area of the skin of Cat II into which the poison had been rubbed. These sections showed a dilatation and thrombosis of many parts of the superficial cutaneous capillary system with plugs of red blood cells. In these places the blood cells were of a distinctly brownish colour. Also it appeared as though a process of disintegration of the cells of the minute thrombi was in progress in places. If in absorption of trinitrotoluene by the skin any quantity of the poison is fixed in the red cells of the cutaneous capillary circulation, it is at least possible that the effects of the concentration of fat-carried poison on the liver are accentuated by a certain further concentration of the poison in the gland, carried by red cells which are undergoing their ultimate stage of disintegration there.

CHANNELS OF ABSORPTION IN POISONING BY TRINITROTOLUENE.

The method of absorption of fat-carried trinitrotoluene from the intestine has already been referred to. The degree of danger connected with the direct inhalation of dust into the lungs is not known, but is probably not considerable. Nor does it appear probable that there is any appreciable danger arising from inhalation of trinitrotoluene in vapour at ordinary temperatures. The danger arising from absorption of trinitrotoluene through the skin is well recognized, and would appear to be proved directly by the observations made in respect of the skin of Cat II. The fixation of the poison by fatty, or fat-derived, constituents of the skin is of special interest in relation to "late" poisoning by trinitrotoluene, in which symptoms of illness may first manifest themselves several weeks after the last exposure to the poison. This late cumulative effect occurs, so far as I am aware, in only one other recognized class of poisoning—that caused by arseno-benzene compounds. In the case of poisoning by trinitrotoluene, the late action has been explained by assuming a cumulative effect of small quantities of the poison absorbed gradually from the skin. The explanation is not altogether satisfactory. It is not clear, by any means, that a poison fixed in the superficial fatty constituents of the skin, themselves in the way of elimination from the surface of the skin, would be taken up and carried internally. On the other hand, we know that blood thrombosed in the cutaneous capillaries, as happened in the experiment on Cat II, will be absorbed gradually, and with it the benzene poison. It may be, therefore, that the red blood cells have an effective part in these cases. It has been said that it does not appear to be probable that any of the poison which has become fixed in the fatty constituents of the skin will become absorbed directly from the skin, but rather will ultimately be eliminated from the surface. At the same time it is not certain that trinitrotoluene fixed in the skin in organic combination may not be absorbed in another way, indirectly by inhalation. It is known from recorded experiments that trinitrotoluene, as such, is volatilized freely only at relatively high temperatures, and that animals exposed to such volatilized trinitrotoluene are not readily affected. But it is doubtful as to how closely these experiments bear on the conditions prevailing when the trinitrotoluene has become fixed in the skin in organic combination, and possibly with some alteration of its constitution. It may be that the fixed poison is volatilized slowly from the skin at the body temperature, so that the patient—when warm in bed, for instance—is continually inhaling small quantities of the vapour.

THE PREVENTION AND TREATMENT OF POISONING BY TRINITROTOLUENE
AMONGST MUNITION WORKERS.

It remains to be considered to what extent the views expressed as to the pathology of poisoning by trinitrotoluene are applicable to measures for prevention and treatment. Little need be said as to the general

administrative measures carried out to protect the worker from undue exposure to the action of the poison. Such measures have been planned skilfully, and carried out with, it is understood, a large measure of success. One point, however, in connexion with the protection of the individual worker must be referred to particularly. Because of its high fat-content, and in view of the ready solubility of trinitrotoluene in fats, milk—as all other foods of a fatty kind—should be avoided as much as possible. Fatty foods, in effect, will favour the absorption of the poison from the intestine. The fatty constituents of the munition worker's dietary should be replaced, as far as may be practicable, by sugars—by glucose and by fructose supplied in fruit foods. The elimination of any trinitrotoluene already fixed in the fatty constituents of the skin should be promoted by frequent warm baths, and especially vapour baths, followed by brisk friction of the skin. Equally, the administration of milk, or any other fat food, in the course of the treatment of declared poisoning is inadvisable. Whatever may be the exact causation of the disease of the liver, two facts are outstanding. In the first place, the liver functions become seriously disordered, so that the gland is no longer able to carry out effectively its part in fat metabolism. In the second place, a condition of excessive lipæmia is established. Under these conditions all fats should be cut off from the dietary, so that the effects of the existing lipæmia may not be aggravated, and so that the liver may be relieved of its metabolic work as far as may be. As in preventive treatment sugars should be substituted for fat foods, definite doses of glucose being given together with fruits. The sugar given thus is given not only in substitution for fatty foods, but also because of theoretical considerations which suggest that oxidation of the excessive floating fat will be favoured by its administration. The diet then should consist mainly of carbohydrates, with very small quantities of lean meat, or preferably fish—excluding the fatty kinds, such as herring, mackerel, etc. It has been suggested that the natural elimination of trinitrotoluene fixed in the skin is outwards. Therefore, apart from the removal of the fixed poison by means of chemical solvents, the free use of warm vapour baths, followed by friction, is indicated from the very commencement of illness. Vapour baths have been used extensively in the treatment of poisoning, but mainly for another purpose and in the later stages when symptoms of coma are threatening.

In conclusion, I have to express my thanks to Miss Margaret Fraser, M.B., B.S., Physician to the South London Hospital for Women, who has kindly allowed me the use of material from cases under her care, and to Miss Hilda K. Whittingham, M.B., B.S., D.P.H., Bacteriologist in the Hygiene Department, Royal Army Medical College, who has assisted throughout the work.

THE SYMPTOMS OF ACUTE CEREBELLAR INJURIES AS OBSERVED IN WARFARE.

BY LIEUTENANT-COLONEL GORDON HOLMES.

Royal Army Medical Corps.

(Continued from p. 475.)

(C) *The Rebound Phenomenon.*—Several years ago in a paper written in collaboration, Dr. Grainger Stewart and I pointed out a sign of cerebellar involvement that is of considerable importance in the interpretation of the disturbances of voluntary movement produced by this condition. The patient's elbows are supported on a bed or table and he is asked to pull each hand in succession towards his mouth against resistance offered by the observer who grasps his wrists; when this resistance is suddenly released the hand of the affected side flies to his mouth or shoulder, often with considerable violence, but the movement of the normal limb is arrested almost immediately by a contraction of the antagonists (triceps), and may even be jerked back or rebound. The rebound is excessive in spastic limbs.

The absence of this rebound may be demonstrated in various other actions, as extension of the elbow, elevation or depression of the arm at the shoulder, flexion or extension of the hip and extension of the knee. It occurs only on the same side as the lesion when this is unilateral, but it is seen on both sides when the wound is bilateral. It is only necessary to resist any movement which the patient attempts to perform and remove the resistance suddenly; then the limb or the segment of the limb which he wishes to move swings unchecked or excessively in the direction of the movement attempted and is not quickly arrested as the normal invariably is. If a hand is placed on the antagonistic muscles it is found that these do not contract, or they come into contraction too late.

The occurrence of this "rebound phenomenon" in lesions of the cerebellum has been confirmed by other observers (Bing, André-Thomas) and it was easily demonstrable in all cases of my present series in which there were moderate or severe lesions. As a rule it was equally pronounced at all joints, though it was usually more definite in the upper than in the lower limb, and more easily evoked at the proximal than at the distal joints. It often happens that it becomes less easy to demonstrate after it has been tested for several times, owing to a voluntary effort on the part of the patient to suppress it, especially if the unchecked movement may produce pain or discomfort.

A similar inability to arrest passive movement quickly may be seen if the observer supports the elbow with one of his hands, while with his

other he first moves the patient's forearm about aimlessly and then unexpectedly throws the hand towards his face. The passive flexion of the normal arm is quickly checked, but the affected hand flies, often violently, into the patient's face, just as a flaccid paralysed limb or a loosely-hinged rod would.

Further, if when his elbows are supported, the patient attempts to flex and extend his forearms alternately as quickly as possible the range of movement on the affected side is often excessive, and more than one patient has complained that he has actually jarred or hurt his elbow-joint by the excessive flexion, which is arrested only by the structure of the joint or by its ligaments, and not by contraction of the antagonistic muscles.

This phenomenon is always most pronounced in the early and acute stages of a cerebellar injury and diminishes gradually as improvement sets in. It is consequently more prominent when the limbs are hypotonic, but its relation to hypotonia will be discussed later.

(D) *Adiadochokinesis*.—Babinski originally pointed out that a patient with cerebellar disease is almost always unable to execute alternate movements as quickly and correctly as the normal person, and he termed this symptom *adiadochokinesis*. It may be tested at any joint at which such movements can be easily and rapidly performed, as flexion and extension, or pronation and supination of the elbow, or flexion and extension of the fingers, ankles, or toes.

When a patient with a unilateral cerebellar injury is asked to pronate and supinate his forearms alternately and as rapidly as he can a very striking difference is noticed between the movements on the two sides, as the rate of the alternate movements of the homolateral limb is slower and much less regular, their range is less uniform, and both the slowness and the irregularity in rate and range become more pronounced the longer the effort is continued. In slight injuries the awkwardness of the attempt and the apparently greater effort necessary for it on the patient's part are more striking than the slowness of its execution, and in very limited lesions or when recovery sets in only this awkwardness and incompleteness may be observable.

Further, while the other joints of the normal limb remain fixed, on the affected side various adventitious movements occur, as irregular flexion or extension of the fingers and more particularly flexion and extension of the elbow, or adduction and abduction at the shoulder. These are generally obvious at once, but if not pronounced the observer by placing his hands under the elbows can feel that while that of the unaffected arm remains steady, the other is jerked about irregularly. Similar adventitious movements at the wrist and elbow can be often observed when rapid flexion and extension of the fingers are attempted, and in the knee and ankle when he is asked to move his toes only.

If the limb is hypotonic part of the adventitious movements may be attributed to flail-like flopping of its distal segments; when for instance the elbow is rapidly flexed and extended the wrist swings about inertly, flexing as the hand is brought towards the shoulder and extending as the elbow is rapidly straightened; and in the same test the elbow is often raised from its support by the momentum of the flexing arm. They depend partly therefore on the failure of the fixing muscles to preserve the correct posture of those segments of the limb that should not move. But there can be no doubt that they are largely due to the active contractions of muscles that are not directly concerned in the act attempted by the patient; this can be easily determined if the arm and shoulder muscles are carefully palpated while rapid pronation and supination of the forearm is attempted; or if a hand is placed on the thigh as the patient attempts to flex and extend his toes rapidly the irregular contractions of its muscles, which produce movement of the knee, can be felt. There is consequently a tendency to an irregular spread of the innervation to other muscles than those which under normal conditions execute the act. When the test is prolonged the movements which the patient wishes to perform may be in fact largely replaced by irregular aimless displacements of other segments of the limb.

Occasionally even the active muscles do not work together accurately and harmoniously, and this increases the awkwardness and irregularity of the patient's attempts; in rapidly flexing and extending the fingers for instance, all these at first move together as they invariably do in the normal limb, but after a time they frequently get out of line and cease to flex and extend simultaneously or to the same extent. I have even seen the thumb bent involuntarily into the hand and thus interfere with the excursions of the fingers.

The slowness and irregularity can be equally well seen in more complex actions, as in shaking hands, clapping hands, rubbing a mark off a sheet of paper, stamping his feet, etc. When a patient attempts to clap hands both arms generally move at first, but the affected one soon comes to a standstill and is then only passively displaced by the blows of the normal hand.

The causes of this disturbance can be more easily analysed if some simple action, as tapping a table or the observer's hand, is carefully examined. In the first place the range of movement is irregular; his hand is occasionally raised too high or brought down too firmly, but more commonly it is smaller than that of his normal limb. Often indeed the movement is arrested too soon and the hand may not actually come to the table. The slowness is due chiefly to delay at the turn and not to time lost in the movements themselves, for there is rarely much difference in the rate of these and of those of the normal limb.

The principal features of adiadochokinesis may be seen in figs. 8 and 9. Fig. 8 reproduces tracings of alternate pronation and supination of the forearms, in a patient with a right-sided lesion in whom this symptom

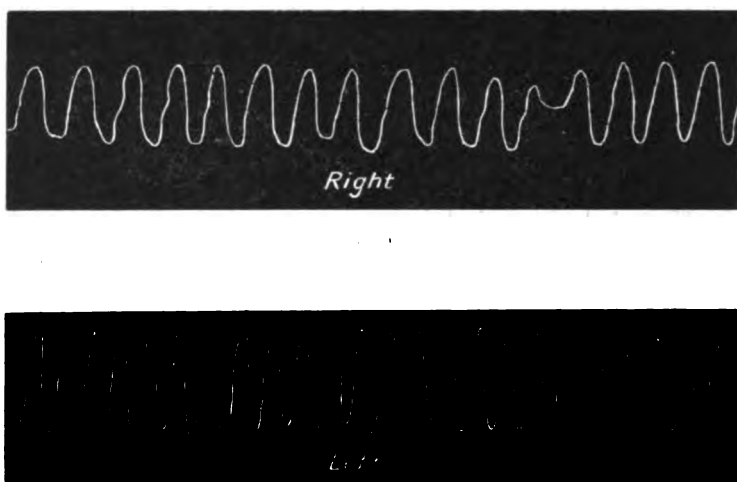


FIG. 8.—Adiadochokinesis. Tracings of pronation and supination of the forearms in succession when performed as rapidly as possible by the patient, in a man five weeks after the onset of a moderately severe right-sided lesion.

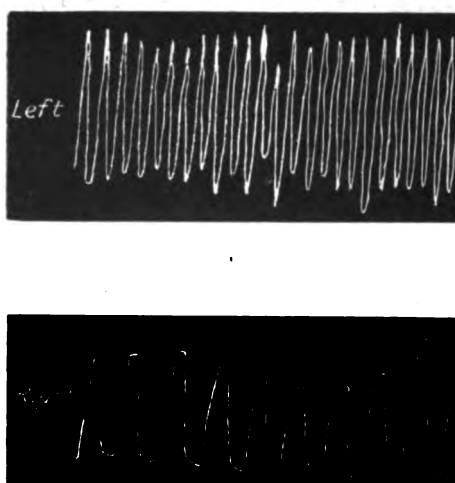


FIG. 9.—Adiadochokinesis. Tracings of alternate flexion and extension of the fingers performed in succession as rapidly as possible by the patient; flexion is represented by the downward lines, extension by the upward. From a man forty-one days after the infliction of a severe right-sided cerebellar wound.

was rapidly disappearing. The range of the excursions of the affected (right) arm was fairly regular, though on one occasion the movement was checked in semi-pronation, but it was considerably smaller than that

of the normal limb; the slower rate was due chiefly to time lost at the turn and to slowness in the initiation of each sequence of muscular contractions. In fig. 9 tracings obtained from rapid flexion and extension of the fingers are reproduced; here the same features are present, but the delay at the turn of the movement, and especially in extension of the fingers, is more obvious.

The occurrence of adventitious movements certainly contributes to the awkwardness and slowness, since they confuse the patient in his efforts, and often put the contracting muscles at a mechanical disadvantage. Consequently we can conclude that the condition described by Babinski as *adiadochokinesis* is due to disturbance of the range of movement and to a slowness in initiating each excursion of the limb, while the occurrence of adventitious movements is partly due to lack of proper co-operation on the part of those muscles which should fix other joints of the limb, and partly to irregular purposeless contractions of other groups of muscles.

Frequently such alternate movements can be better performed by the affected limb when it is tested alone than when both limbs are examined simultaneously. The normal person generally finds it easier, or at least as easy, to perform such rapid alternate movements simultaneously with his right and left limbs as with either separately, but when a unilateral cerebellar lesion exists the more rapid movements of the normal limb seem to confuse those of the affected one and disturb their sequence. The patient has, consequently, to attempt two different actions at once instead of the same action simultaneously with his right and left limbs.

Adiadochokinesis can usually be demonstrated at all joints of the affected limbs, even when only limited lesions exist, but it is usually more pronounced in the arm than in the leg and in complex than in simple actions. During recovery the slowness, irregularity and awkwardness diminish gradually, but *adiadochokinesis* is one of the most persistent of the ordinary signs of cerebellar injury.

The majority of the abnormalities of movement described above refer to those in which the larger and more proximal groups of muscles are concerned, but similar disturbances can be observed in the finer and more elaborate actions of the hand which are peculiar to the anthropoid and especially to man. The slowness, awkwardness and irregularity of the finger movements in handling objects, and the difficulty in bringing each finger of the affected hand separately and accurately to the tip of the thumb have been described above, but these defects are even more apparent when the patient attempts to use simple and familiar tools. When a man with a right-sided cerebellar lesion was given a pair of scissors he had, in the first place, difficulty in grasping them correctly, then failed to direct them properly and was unable to move the blades regularly and appropriately when he attempted to cut a piece of paper with them.

In writing, too, these disturbances are very obvious when the wound involves the right half of the cerebellum. The pencil is held incorrectly and insecurely, grasped too tightly, and its point is pressed much too firmly on the paper. The letters are frequently unequal in size and irregularly spaced; the individual letters are badly formed and their lines are often jerky and angular. Further, as he writes it can be seen that he pauses frequently, especially between the up and down strokes, and the movements of his pencil are consequently interrupted and discontinuous. If he uses a pen he is liable to run its point through the paper and make ink splashes; his attempt with it is therefore less successful (fig. 10).

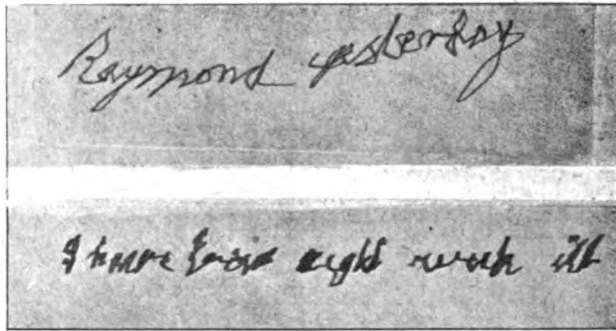


FIG. 10.—Specimens of the writing of two men with right-sided cerebellar injuries. The upper is of the words, "Raymond, yesterday"; the lower, "I have been eight weeks ill."

Static Tremor.

I have not observed tremor in any case while the limbs and body were at rest and fully supported, but it often appears during the maintenance of posture that requires muscular contractions. That which occurs during movement has been already described as a component of "cerebellar ataxy."

When a patient with a unilateral cerebellar lesion sits or stands there is frequently tremor of his head, which usually consists of fine or moderate irregular oscillations in any or all directions; it increases as he becomes tired. Similarly, when standing his whole body is often displaced by larger and more irregular swaying movements. This unsteadiness seems to be due to irregular and discontinuous contractions of the muscles that should maintain the attitude.

Tremor is as a rule seen in the affected limbs only when he strives to adopt a posture or as they tire, which they do more rapidly than the normal. When an attitude is once attained, as when his arms are outstretched horizontally in front of him, or his legs raised from the couch and flexed to right angles at the hip and knee, the affected limb is usually held for a

time as steady as its fellow, and often indeed even more so. It is noteworthy that the fine vibratory tremor which can often be seen in the normal arm, and even more distinctly felt, when it is held rigidly extended and unsupported, is generally absent in the affected limb; in one case its absence was so obvious that the photographer who exposed a plate as the patient held his arms in this position remarked how much steadier the affected one was. This condition corresponds to that which Babinski has described as *cerebellar catalepsy*, or the property of limbs remaining for a long time immobile under the influence of will; but otherwise I have seen no evidence of this symptom in the earlier stages of cerebellar lesions. On the contrary, when the limb begins to tire, and especially if it is still asthenic, a coarse tremor often develops, which is partly due to failure of sustained contraction of the fatigued muscles, but largely to the repeated voluntary attempts of the patient to bring it back to the position from which it tends to fall away. The tremor which occurs in these conditions is comparable to nystagmus and consists of two phases, namely, slow displacements by gravity and quicker voluntary jerks back towards the original position.

Before describing the abnormalities of standing and gait produced by unilateral cerebellar lesions, it is advisable to consider other symptoms which influence them. These are particularly the attitude assumed by the patient and the occurrence of vertigo.

Vertigo.

Many text-books include vertigo among the symptoms of cerebellar disease, but much doubt has been thrown on its direct relationship to cerebellar lesions; in fact, most authorities attribute it to affection of the labyrinth, or of the vestibular nerve or its nuclei.

Giddiness is an extremely common symptom after all gunshot injuries of the head, and almost all patients in whom the cerebellum is involved state on questioning that they were giddy at first or after regaining consciousness. From many of these no accurate description of the sensation could be obtained; but this is not surprising as most men are dull, obfuscated and unobservant for some time after being wounded in the head. Seventeen men, however, described apparent displacement of self, or of external objects, or of both. In twelve of these self and the external world seemed to be simultaneously displaced; in three there was apparent movement of self only, and in two solely of the external world. In fourteen of these seventeen cases the displacement took the form of rotation around the longitudinal axis of the patient's body; in two they were in the vertical plane; while one man stated that the walls of the room in which he lay seemed to be receding from him.

Among these fourteen patients the same difficulty was experienced in

attempting to determine definitely the direction of the rotation, since the vertigo rarely persisted more than one or two days. In almost all the subjective rotation of self and the movement of the outer world were in the same direction, but no constant relation could be discovered between the direction of the rotation and the site of the injury. In a series of cases of cerebellar tumour Dr. Grainger Stewart and I found that when vertigo occurred in patients with unilateral lesions the sense of movement of self and of external objects was from the side of the lesion towards the opposite side; but my present series, in as far as one can rely on the statements of the patients, does not confirm this rule.

It is interesting, however, that in the only three cases in which vertigo associated with actual movement occurred under observation, the patients rotated from the affected towards the opposite side (i.e., the shoulder of the affected side moved forwards) and the apparent movement of the external world was in the same direction. In the early stages of other cases too, there was a noticeable tendency for the patients to lie on the affected side. Some expressed considerable reluctance to rest in any other position, though one man stated that if he fell asleep lying on this side he was liable to roll over on his face. Consequently when "forced movements" were observed they took place in the same direction as they do in animals after ablation of one half of the cerebellum.

Further, the common attitude of a patient with a unilateral cerebellar injury, the head rotated towards the opposite side and the homolateral shoulder in advance of its fellow, may be looked upon as a latent tendency to rotation in this direction.

In the two cases in which during vertiginous attacks a sensation of vertical displacement only occurred, external objects seemed to rise in front of the patients, and one man complained that simultaneously his head seemed to be sinking back through the pillow. In both of these men the wound was over the middle of the posterior surface of the cerebellum, which was also much the most common site in the series as a whole.

Spontaneous Deviation of the Limbs and the Pointing Test

which Bárány has described, especially in connexion with labyrinthine vertigo, may be dealt with here.

In order to examine for spontaneous deviation of the upper limbs the patient is asked to hold both arms extended horizontally in front of him and close his eyes. It is advisable for the observer to steady his hands and check any tendency to movement till his eyes are closed. Then in the majority of cases with unilateral lesions the homolateral arm swings either slowly or abruptly away from the symmetrical position and comes to rest gradually. This occurred in all the thirty-three

cases in which it was looked for. In thirty-two the arm swung outwards, and in one slightly inwards, but the latter case, in which one lateral lobe of the cerebellum was almost completely destroyed and death occurred on the third day, may be neglected as the arm was so asthenic that it could scarcely be raised. We may consequently assume that the involuntary deviation of the unsupported arm is almost constantly outward.

While the observer's hands are steadying the patient's arms he can often feel a definite tendency to active displacement of the homolateral arm in this direction.

When in slight injuries this deviation is not obvious, it may be brought out by shaking or tapping the affected arm, this then generally moves in the direction towards which it tends to deviate.

Frequently the arm also deviates upwards or downwards from the level in which it was originally placed.

Bárány's pointing test confirms these observations. The patient's extended forefinger is placed in contact with some fixed object, as the observer's finger, which is held at some distance above the bed, and he is then asked, while his eyes are closed, to bring his finger down to the bed and slowly up again to the object; with his normal arm he can reach the mark accurately or approximately on each attempt, but in most cases the forefinger of the affected side deviates constantly to one side of it, and this deviation increases for a time if the test is continued. In order to avoid conscious efforts to correct the error it is advisable for the observer to allow the moving finger to strike a similar object that can be moved into contact with it; if a tape measure is held horizontally in such a position that the patient's finger must touch it the error in each movement can be easily measured. If the more proximal segments of the limb are fixed the tendency to deviation of its distal segments can be investigated in the same manner. In the early stages of an extensive injury, the homolateral limbs are often so asthenic and ataxic that the test cannot be easily employed.

In all the thirty-two cases of unilateral lesions, involving different parts of the cerebellum, in which the arms were tested, a tendency to deviation was observed in the limbs of the affected side, and in all the deviation was outwards from the vertical when the arm was moved at the shoulder only. In certain cases vertical movements at the elbow and wrist were also examined, and in these, too, the deviation was constantly outwards, though the error was here much smaller.

In twenty-seven cases movements in the horizontal plane were similarly investigated; in nine progressive deviation upwards occurred, in seven the error was downwards, in six there was no tendency to deviation, and in the other five the direction of the error was irregular. The direction of the error in horizontal movements is not, however, always constant, in a few cases it was in one test upward and in another downward.

When this test is first seen these errors towards a fixed point in movements that are not controlled by vision suggest strongly a disturbance of the sense of position or of the appreciation of movement ("muscle sense"), in the affected limb, but it can be easily demonstrated that this does not exist; the patient can, for instance, while his eyes are still closed, bring his other forefinger accurately and promptly to the tip of that one which is actually several centimetres distant from the point he wishes to touch by it, showing that he is fully aware of its position in space. This can be confirmed by other tests too.

A tendency to deviation of the lower limbs is less common and the error is less pronounced when it exists. It is remarkable, however, that while the affected arm constantly, or almost constantly deviates outwards, the homolateral leg generally swings inwards (adducts), or is raised obliquely upwards and inwards over the opposite limb. In fifteen cases the pointing test was applied in vertical movements; in four there was no appreciable error, in two the leg deviated outwards, and in nine progressively inwards.

Another feature brought out by the pointing test is a remarkable tendency of the affected limb to overshoot the mark; while the normal limb is arrested at or near the position of the object which the patient wishes to touch, the affected one almost always swings past it, and often as much as 30° to 45° beyond it. This is obviously a manifestation of dysmetria; no disturbance of any form of sensation that could be responsible for it was demonstrable in any case.

Attitude.

Abnormal attitudes, which are such a prominent feature in animals after experimental lesions of the cerebellum, are much less constant and striking in man. Considerable importance has, however, been attached to the position of the head in cerebellar disease, especially when the affection is unilateral; in gunshot injuries its significance is generally doubtful, since the wound frequently involves the cranial attachments of the neck muscles, and because the patient naturally assumes the position which is most comfortable or which gives him least pain. As a rule, however, the head tends to be flexed towards the side of the wound and rotated towards the opposite side, so that the chin approaches the contralateral shoulder and the occiput is consequently approximated towards the shoulder of the affected side. This is particularly striking in cases in which the wound has healed.

Special attitudes of the trunk are less obvious, but in the early stages of an injury the body is often concave to the side of the lesion even as the patient lies on his back; this is usually more prominent when he sits up, but as he then inclines to and tends to fall towards this side the

upper part of his trunk is often purposely bent over in order to maintain equilibrium so that his spine is convex in this direction.

In certain patients, especially in those who are still or were recently subject to vertigo, the upper part of the trunk also tends to rotate towards the unaffected side (i.e., the homolateral shoulder is advanced), especially when they close their eyes; this attitude can be made more distinct by gently shaking the bed or the chair on which they sit.

In some of my patients, and particularly in those in whom the vermis cerebelli was also involved, the face was stolid and expressionless.

The flaccid and hypotonic limbs generally assume any posture into which they fall or are moved, or which may be given them by gravity, but when the patient holds the arms outstretched that homolateral to the wound is frequently more abducted than its fellow, and in several cases it is described in my notes as more rotated inwards at the shoulder and pronated at the elbow. In a few cases the hand of this side tended to be saddle-shaped, with the wrist flexed and the fingers hyperextended at the metacarpo-phalangeal joints, when the arms were held out.

There is no common noteworthy attitude of the lower limbs as the patient sits or lies in bed.

Standing and Gait.

When a patient who is able to leave bed is placed on his feet for the first time he is shaky, uncertain and unsteady, his whole body sways irregularly, his head oscillates, and he is usually in considerable danger of falling, especially towards the side of the wound and backwards. It often seems as if he were impelled to this side; several patients have, in fact, complained that they felt that they were pulled over, as though by an invisible hand, in this direction. It is, however, remarkable that even after being confined to bed for several weeks with a wound of one side of the cerebellum the patient can generally maintain his equilibrium, and make awkward though appropriate and often successful attempts to recover it if it is threatened. At this stage his attitude in standing is very striking; his head and trunk are both inclined to the injured side and his spine is concave to it, but his pelvis is so tilted that his weight falls chiefly on his opposite foot. The homolateral shoulder is generally higher than the other and it is almost always in front of it, and the trunk is occasionally rotated on its longitudinal axis towards the unaffected side. The homolateral leg is usually abducted and sometimes rotated outwards. His whole body is held stiff and rigid, and even when in danger of falling he does not sway it naturally in his efforts to save himself.

If he is gently pushed to either side, or if his shoulders are tapped firmly, it is found that he can be more easily thrown over towards the side of the lesion and that he makes less appropriate efforts to save him-

self when falling in this direction. Finally, he can usually stand on his unaffected leg alone, but when he attempts to place his weight on the homolateral limb, he sways and staggers so much that considerable support may be necessary to prevent him from falling. In cases of severe injury this leg also tends to give way suddenly under him as though it were too feeble to bear his weight.

It must be emphasized that the patient can stand as securely with his eyes closed as when they are open, there is consequently no tendency to Romberg's sign. On the other hand, he becomes more unsteady and is in greater danger of falling if his attention is diverted, even if only by conversation; he obviously supplements the normal muscle reflexes that preserve equilibrium by voluntary effort.

When such a patient attempts to walk many remarkable features are seen in his gait. If the lesion is severe and extensive he has often much difficulty in preserving his equilibrium and is frequently in danger of falling, though almost all men with unilateral lesions succeeded in walking unaided on the first day they left bed; this varied between eight and seventy-one days after the infliction of the wound.

The first and most striking feature is the patient's obvious fear of trusting himself on the affected leg. He throws his weight on it slowly and cautiously, and at each step hurries off it by bringing the other limb forward and to the floor, as quickly as he can. At the same time he stumbles, and tends to fall to this side. His steps are generally short, unequal in length, and irregular. In advancing the affected leg, the foot is occasionally dragged along the ground, but more frequently it is raised, unnaturally by excessive flexion of his knee and hip, and is brought down with undue force. Further, it often comes irregularly to the floor, the whole sole falling on it simultaneously, or the toes before the heel; and, occasionally, either the inner or the outer margin of the foot alone may first come in contact with it.

This leg is usually abducted and rotated somewhat outwards, but this is not constant; often, in fact, the homolateral foot is brought in front of the other in one step, and in the next is abducted too much.

When the patient is able to walk safely alone, he still stumbles to the homolateral side, and reels abruptly from his proper course in this direction; in walking between two rows of beds, he is therefore liable to run into that on his affected side. He consequently takes a zig-zag course, the abrupt deviations being always towards the side of the lesion, except when he stumbles awkwardly, as he often does, towards the other side in an effort to save himself, or to correct the deviation. The stumbling is often due to excessive adduction of the affected limb, owing to which its fellow in being advanced trips on it; but it is most commonly a manifestation of the tendency to fall to the affected side.

In walking along a straight line he deviates, or shows a tendency to deviate, towards the affected side. This is usually more obvious when his eyes are closed; then his course is often a parabolic curve concave to the side of the lesion. His attitude, with his head rotated towards the opposite side, the homolateral shoulder in advance of its fellow, and the transverse axis of his body consequently oblique, often gives the impression that his direction, even when he walks straight, inclines to the homolateral side of the line he intends to follow.

This tendency to deviation can be well demonstrated by making the patient walk round a chair or a small table; when the shoulder of his injured side is inward, he frequently runs into the chair, while he constantly deviates outwards from it, so that he traces an opening spiral, in walking round it in the opposite direction. In walking backwards, on the other hand, especially when his eyes are closed, he generally deviates in a sharp curve concave towards his affected side.

The patient soon becomes aware of this tendency to stumble, reel, and deviate towards his affected side, and attempts to control it; occasionally, indeed, in his efforts to prevent falling to the one side, he actually stumbles to the other. These symptoms are usually most marked when he walks quickly; but a few patients got along better rapidly than slowly and deliberately.

Further, when walking quickly, he has difficulty in stopping suddenly; when ordered to halt, he often cannot pull up for two or three steps; or, in attempting to do so, he may throw himself forwards so abruptly on to his toes that he is in danger of falling on his face. In certain cases the difficulty in stopping when walking backwards was even greater—one man, for instance, on taking a step or two backwards, could not pull himself up till he ran into some object, or was assisted, for several weeks after the infliction of the wound. This difficulty in stopping resembles that seen in paralysis agitans, in so far as it is due to the legs having to move after the body in order to keep the centre of gravity above the base of support; but in cerebellar lesions it must be attributed to deficient synergia of the trunk and thigh muscles by which this should be promptly attained. Another example of asynergia is furnished by the fact that as the patient walks the affected arm hangs inertly by his side, and does not swing synchronously with the movements of the opposite leg; nor does he use this arm naturally in attempting to balance himself. Further, when he is in danger of falling, he does not move either his trunk or arms naturally or adequately in attempting to regain equilibrium, and if he is suddenly pushed in any direction he falls stiffly and rigidly like a doll.

In cases of unilateral cerebellar lesion the chief abnormalities in gait are therefore due to the irregular and incorrect placing of the affected foot, and to the tendency to fall, stumble, and deviate towards the affected

side. The patient soon attempts to correct these disturbances by voluntary effort; he throws his weight as little as possible on the unsafe leg, and when he can control his direction by vision, he checks, though rarely completely, his tendency to deviate from the direction he wishes to follow.

The disturbances in gait are, it is true, usually greater in relation to the disorders of movement of the affected leg, when this is tested as he lies on his back, than might be expected; but the symptoms of cerebellar deficiency are always most obvious in the most complicated actions, and more complex synergias, involving both the trunk and limb muscles, are called into play in maintaining equilibrium and direction during gait than are required in movements of the leg alone. Many of the older physiologists and certain clinicians have regarded the cerebellum as an organ concerned mainly with the maintenance of equilibrium; but this hypothesis finds no support in the examination of men in whom one side of the organ only has been damaged; in fact, the successful efforts to maintain equilibrium, despite the patient's deficient control over the movements of the one leg, are often surprising.

When a man who has recently left bed attempts to progress on his hands and knees, similar disturbances are seen. The affected arm is abducted, this shoulder is held lower than the other, his trunk is concave to the side of the injury, the hip of this side is depressed, and the leg is usually somewhat adducted. In moving forwards, the affected arm is raised too high, and the hand swoops down too heavily to the ground; the homolateral knee, on the other hand, is generally dragged along the floor. The patient occasionally falls to the side of the lesion, but more frequently he merely slides over to this hip, owing to its excessive adduction, or to the leg giving way under him. The similarity both in attitude and progression on the hands and knees between a patient with a unilateral destruction of the cerebellum and a dog or monkey after ablation of one half of this organ, is consequently very striking.

Disturbances of the Ocular Movements, and Nystagmus.

In animals subjected to cerebellar injuries disturbances of the ocular movements have been observed, but little emphasis has been laid on the occurrence of nystagmus; this is not surprising, as it can be properly investigated only on voluntary movements and fixation of the eyes, and with the co-operation of the subject. Many physiologists have even refused to admit that the nystagmus is dependent on the cerebellar lesion (Munk, Rothmann). It is however remarkable that even from most clinicians these symptoms have not received the attention they deserve; the reason probably is that they are particularly prominent only early after acute lesions.

For some days after a unilateral gunshot wound of the cerebellum the eyes while at rest are generally deviated towards the opposite side, especially

if the patient happens to be unconscious, and at first it is often difficult to make him move them conjugately towards the injured side. When he attempts this the range of movement is occasionally incomplete, but usually a more striking feature is its slowness and the effort necessary to execute it. In one patient at least in whom it was carefully investigated this conjugate paresis was associated with erroneous projection towards the homolateral side. The paresis diminishes gradually but the difficulty in movement to this side, in comparison with deviation in the opposite direction, frequently persists for weeks. The vertical movements of the eyes and convergence are never similarly affected.

In five cases the position known as "skew-deviation" was observed, that is, the homolateral eye was directed downwards and inwards while the other looked upwards and outwards. This lack of parallelism in the optic axes disappeared however on fixation when this could be obtained, and consequently diplopia did not result. Skew-deviation was observed only during the first week or so after an injury of or an operation on the cerebellum, except in two cases in which rapid destruction or compression of this organ, owing to abscess formation occurred.

Nystagmus is a much more common symptom; it was present in fact in almost every case in which injury to the cerebellum produced any trace of functional disturbance, and its chief characters are so constant that it must be regarded as a clinical symptom of the highest importance. It is essentially a fixation nystagmus, that is, it can be seen as a rule only when the patient fixes an object.

It is advisable to describe it first as it most commonly occurs in the early stages of a severe unilateral lesion. In such a case some nystagmoid jerks can be usually observed when the patient fixes an object in any part of his visual field, except in the region of that point, usually 10° to 30° to the unaffected side of the middle line, towards which his eyes when at rest tend to deviate. We shall speak of this as the "rest point."

When he looks at an object held directly in front of him his eyes tend to deviate slowly towards the unaffected side and are brought back to the middle line by sharp jerks of small or moderate range. These movements are usually slow in rate and at first regular, but when the patient's effort or attention begins to tire his eyes may move more widely before their deviation is checked, and the correcting jerks consequently become less regular in rate and larger in range.

It is on looking towards the injured side however that the nystagmus is most pronounced, then it consists of wide, slow deviations towards the middle line, or more correctly towards the "rest point," and forcible jerks of large amplitude, slow in rate and fairly regular in rhythm, towards the side to which the eyes are voluntarily directed. Its rate was estimated in several patients and in all varied between twenty-three and

thirty oscillations in ten seconds. Both movements are as a rule strictly horizontal, but occasionally slight rotation, generally downwards, may be seen in the quick phase. This nystagmus generally remains regular in rate and amplitude for a short time, but as the patient tires his eyes are less frequently and less completely pulled back towards the point he should fix.

In this stage too there is almost always nystagmus on fixing an object to his unaffected side, but it is more rapid, finer in range and less regular. Here too the slow deviation is towards the "rest point" and the movements are most commonly horizontal. Frequently in looking towards this side the nystagmus consists of series of rapid jerks with short pauses between each series.

Nystagmus is less constant and less regular in vertical movements. In the majority of early cases, however, the eyes on being directed upwards tend to deviate slowly towards the horizontal and are brought back by sharp quick jerks of small range, which are rarely quite regular in rate or well sustained. Almost always there is either some rotation of both eyes upwards and towards the side of the injury in the quick phase, or the quick movement is more or less obliquely upwards and to this side. This occurs especially when the point fixed is brought to the affected side of the mesial sagittal line. On looking downwards regular and sustained nystagmus is rare, but very commonly slow deviations towards the horizontal line occur, which are corrected by quick, relatively small jerks vertically downwards, or more frequently obliquely downwards and to the side of the lesion, or with rotation to this side. The nystagmus that occurs on vertical movement always increases, or it may appear only when the object fixed is brought to the homolateral side of the middle line.

Finally, on convergence both eyes often tend to deviate away from the side of the lesion and are brought back to their proper position by irregular jerks of small range.

Unless there is much paresis of conjugate deviation towards the injured side the movements are more regular, larger in range and better sustained the farther the point fixed is from the primary central position, or rather from the "rest point," and the jerks increase in range and accelerate in rate when the point is moved farther from this position. The nystagmus also tends to become less regular and less rapid as fixation tires, but it can be evoked again by renewal of fixation, especially if the object fixed is moved slightly farther from the middle line.

This is the typical form of nystagmus produced by recent cerebellar injury, but divergences from it are common. Little or no disturbance may be, for instance, seen on movement of the eyes in one direction, though characteristic nystagmus is associated with all other movements; or the relative amount that occurs when the eyes are moved in different

planes may not be typical. These divergences may be partly dependent on the localization of the cerebellar lesion, though I am not yet able to state definitely that this is so. It varies, however, according to the severity of the injury; when this is recent and extensive and the eyes deviate spontaneously towards the unaffected side and movement to the other is difficult, no nystagmus, or only an occasional jerk, may occur when the patient looks to that side, and on fixing to the side of the lesion only a few slow irregular jerks of large range can be seen before the effort at fixation becomes ineffective.

If the lesion is slighter, or some time has elapsed since the infliction of the wound, and there is no obvious deviation of the eyes, and at the most only slight difficulty in conjugate movement towards the injured side, the nystagmus is also less regular and less characteristic. On central fixation the eyes generally remain steady, or only an occasional deviation of small range towards the unaffected side occurs, which is at once corrected by a sharp jerk. On looking towards the side injured a slow, coarse, forcible nystagmus, with its slow phase towards the rest point, still develops, but it is usually less regular and less well sustained. After a time the oscillations become more rapid and smaller in range before the true nystagmus disappears or is replaced by occasional irregular jerks of the eyes. On fixing to the opposite side the excursions of the eyeballs are still smaller in range and more rapid in rate, but they are less regular and persist for a shorter time. Vertical movements are now less commonly complicated by nystagmoid jerks, and these are in fact rare on downward deviation. In a few severe cases there was at this stage more rotation upwards and to the side of the lesion when the patients looked directly upwards, though in one man, in whom the rotation had been previously to that side, it was upwards and in the opposite direction four weeks after the injury was received. Here, however, the mastoid process and the internal ear probably, too, was damaged.

Finally, in cases with very slight injury, or at a later period after the infliction of a severe wound, the only abnormality in the movements of the eyes may be occasional irregular slow deviations towards the middle line and sharp rapid jerks, irregular in rate and in amplitude in the opposite direction, on prolonged fixation towards the injured side; or there may be only slight irregularity of the eyeballs when they are fully deviated in this direction.

It is obvious that the nystagmus produced by a unilateral cerebellar lesion is essentially a fixation nystagmus, that is, it is seen chiefly when an attempt is made by the patient to fix accurately a point in any part of his visual field, but it may also occur when accurate fixation is impossible. In some of the cases spectacles with high convex lenses, such as have been employed by Wilson and Pike, were placed in front of the patient's eyes,

and it was then found that when he moved them to order the oscillations were considerably less marked, or did not occur on deviation in certain directions.

Nystagmus of cerebellar origin is therefore characterized by the facts that it occurs chiefly in fixation, that the slow phase is always towards the primary central position or the rest point, and that it is more constant, more regular, better sustained, and the oscillations of the eye-balls are slower in rate but larger in amplitude, when the patient looks towards his injured side. Finally, it persists for weeks, or even months, after the onset of the lesion, though it gradually becomes less regular, or is replaced by irregular nystagmoid jerkings.

The question as to how far this nystagmus is dependent on co-existing labyrinthine lesions at once arises, more especially since labyrinthine disturbances, as Moutier and others have shown, commonly result from gunshot injuries of the head. It cannot be denied that the internal ear was possibly damaged in certain cases of my series, and particularly in those in which the missile entered through or near the mastoid process, but in the majority it certainly escaped, and no essential difference in the type of the nystagmus could be detected in the two groups. Further, the nystagmus has not the character of that produced by destructive or irritative labyrinthine lesions. We owe valuable contributions on this subject to Gordon Wilson and Pike, and to the former I am indebted for the following distinguishing features of the nystagmus which results from destruction of one labyrinth: it persists at the most only two or three days; it is increased when fixation is cut out by suitable lenses placed in front of the eyes in a spectacle frame or by other means, and the slow phase is always towards the injured side, whether the eyes are at rest or deviated voluntarily towards either side.

If the features of that produced by cerebellar lesions are compared with these, it will be seen that nystagmus of cerebellar origin differs in many important particulars from that due to destructive labyrinthine lesions, and we may consequently conclude that injury of the labyrinth plays no direct part in its pathogenesis.

The nystagmus associated with cerebellar lesions has also been attributed to injury or disease of neighbouring centres, and especially to lesions of Deiters' and Bechterew's nuclei. This factor can be certainly excluded in the majority of my cases, and the regularity with which the characteristic nystagmus occurs, even when the wound is small and relatively superficial, and in the absence of all signs of medullary and pontine involvement, makes it extremely probable that it is due to damage of the cerebellum alone.

(To be continued.)

MALARIA IN MACEDONIA WITH ESPECIAL REFERENCE TO THE USE OF PROPHYLACTIC QUININE.

BY CAPTAIN C. H. TREADGOLD.
Royal Army Medical Corps.

BETWEEN the beginning of February and the end of April, 1917, I had occasion to examine the various units of a certain Division in Macedonia with a view to determining the proportion of men *on duty* who were infected with malaria. Smears from 540 men were stained and searched for parasites, and the results are summarized in Table I. Plasmodia were found in over thirty per cent of the men who had been in Macedonia during the previous summer, while the altered differential leucocyte count suggested that over sixty per cent of such men were in reality infected. Had it been possible to reckon the absentees in the Malta and Salonika hospitals, the total percentage of infected men would, of course, have been much greater.

It is interesting to note that parasites were found in nearly eight per cent of men with no history of fever; if we regard the increased hyaline count as evidence of infection, their number increases to over thirty-seven per cent.

No evidence of infection being found in recent drafts, it may be assumed that the great majority if not all the men in whom parasites were present had been infected during 1916 or earlier.

Technicalities.—The average time spent over each slide was about ten minutes, and no man's blood was examined more than once. Gametes were found in over ninety per cent of the positive slides, and schizonts were also present in a large proportion. *Plasmodium vivax* was the common parasite found; *P. falciparum* was noticed on seven occasions, *P. vivax* being also present in four out of the seven; *P. malariae* was only diagnosed once. To simplify matters, *P. falciparum* and *P. malariae* have been reckoned in the table as *P. vivax*.

THE RESULTS OF QUININE PROPHYLAXIS.¹

Method of Administration.—The salt employed was the sulphate, the daily dose (five to thirty grains) being given either in acid solution or in the form of tablets.

Results of Analysis.—Chemical analysis showed the drug to be pure.

Results of Administration.—The men in Groups I, II and III of Table I had been taking quinine during the greater part of 1916, and I was assured by the regimental medical officers that many were taking it at the time I made the blood films. The material summarized in Table II indicates the

¹ By quinine prophylaxis is meant the regular administration of quinine with a view to preventing the development or recrudescence of clinical malaria.

kind of evidence available. These twelve men belonged to the same brigade, the majority coming from a regiment whose medical officer had had considerable experience of malaria in the East, and who was positive that quinine was being ingested in the doses stated. The persistent slight deafness which was such a characteristic feature in half of them would seem to corroborate his statement.

TABLE I.

Groups	Total examined	<i>P. vivax</i> present	Hyaline leucocytes : 15 per cent or over in men in whom no parasites were found
I.—Macedonia, during summer of 1916; fever within three months of examination	300	120 (40 per cent)	89, thus increasing percentage of presumably infected men to 69·6
II.—Macedonia, during summer of 1916; fever during this period but none within three months of examination	93	16 (17·2 ..)	33, thus increasing percentage of presumably infected men to 52·6
III.—Macedonia, during summer of 1916; no history of fever	63	5 (7·9 ..)	20, thus increasing percentage of presumably infected men to 39·6
IV.—Drafts reaching Macedonia between September 1, 1916, and December 31, 1916; never out of Britain before; no history of fever	40	3 (7·5 ..)	11, thus increasing percentage of presumably infected men to 35·0
V.—Drafts reaching Macedonia in 1917; never out of Britain before; no history of fever	44		

TABLE II.

No. of case	Cinchonism at time of blood examination	<i>Vivax</i> , schizonts and gametes in peripheral circulation	Daily dose of quinine	Length of time since last relapse
1	—	Yes	30 gr. daily for weeks	1 month
2	Tinnitus and deafness, especially on left side	„	„ „ „	3 weeks
3	Slight deafness	„	„ „ „	2 „
4	—	„	20 gr. daily for weeks	3 months
5	Tinnitus and slight deafness	„	10 gr. daily for weeks	3 „
6	—	„	„ „ „	2 „
7	—	„	„ „ „	2 „
8	Slight deafness	„	„ „ „	5 weeks
9	Tinnitus and slight deafness	„	„ „ „	2 „
10	—	„	„ „ „	1 week
11	Slight deafness	„	„ „ „	8 days
12	—	„	„ „ „	1 month

Owing to the varying amounts of quinine ordered by the medical officers attached to the different regiments, it was possible to place 125 out of the 150 men examined during the month of February into one or other of the following groups (*vide* Table III). Whether the quinine was given in

small or large doses or not at all, seemed to make little difference either to the number of relapses or to the proportion of cases in which parasites were found; many of these men were constantly relapsing.

TABLE III.

Groups	Number of cases examined		Number of men in whom parasites were found	
I. No quinine between attacks	..	26	..	16 (61.5 per cent)
II. 30 gr. daily	21	..	11 (50.2 ")
III. 20 " "	9	..	6 (66.6 ")
IV. 15 " "	6	..	4 (66.6 ")
V. 10 " "	48	..	22 (45.8 ")
VI. 15-30 gr. bi-weekly	11	..	3 (27.2 ")
VII. 6 gr. daily and 12 gr. bi-weekly	4	..	3 (75.0 ")

The evidence so far considered indicates :—

(1) That despite infection, a fair proportion of the men examined had—temporarily at any rate—resisted illness or got the upper hand of the disease.

(2) That a great deal of sickness due to malaria nevertheless existed in the Division, much of it being little influenced by the administration of quinine.

The figures available from French sources show an even higher degree of infection, but entirely confirm these observations. For example Garin,² although he gives no details as to the number of men examined, claims that plasmodia—usually gametes—can be found in the blood of from sixty to eighty per cent of troops returning from Macedonia without a history of malaria, while Abrami³ states that from eighty-five to ninety-five per cent of the French Macedonian Army was attacked by malaria in spite of early and general preventive quininisation. An early and correct solution of the following problems is therefore urgently needed :—

I.—Is any appreciable proportion of the Macedonian Force saved illness through the administration of prophylactic quinine? If so, what proportion?

II.—Is the general course of the disease ever affected by the previous administration of prophylactic quinine? If so, is the sum of such influences favourable or the reverse?

To answer these questions as they should be answered clearly demands a very exact knowledge of the conditions upon which the usefulness of the drug, both as a prophylactic and as a curative agent, depend. Unfortunately these conditions have never been thoroughly investigated on scientific lines and large gaps in our knowledge consequently exist. In spite of these drawbacks I have been tempted to analyse and draw conclusions from the data available in the literature of the subject.

² Garin, *Presse Médicale*, June 4, 1917.

³ Abrami, P., *Presse Médicale*, March 22, 1917.

I.—Is any appreciable proportion of the Macedonian Force saved illness through the administration of prophylactic quinine? If so, what proportion?

The question will be considered under the following headings:—

- (a) General considerations followed by an analysis of the available statistical evidence.
- (b) The different methods of giving prophylactic quinine.
- (c) The rôle of suggestion in quinine prophylaxis.
- (d) Conclusions.

(a) GENERAL CONSIDERATIONS FOLLOWED BY AN ANALYSIS OF
THE AVAILABLE STATISTICAL EVIDENCE.

Altogether I had access to some two hundred original articles, reports of medical societies, etc., in which the question of quinine prophylaxis was either dealt with or discussed. Nearly all of them were written in English, French or German, and all—with one exception—were published between the discovery of the malaria parasite in 1880 and the present time. 52·2 per cent of authors gave no details of their personal experience, while only 16·9 per cent made use of controls. Table IV gives an idea of the opinions expressed by these different writers, no less than eighty per cent of whom were in favour of quinine prophylaxis.

TABLE IV.

	In favour of quinine	In favour of quinine with reservations	Against	Total
No statistics	65	21	20	106
Statistics but no controls	43	6	12	61
Statistics with controls	26	0	8	34
Total	134	27	40	201

The majority of these papers were, however, devoid of interest. No doubt a large number of writers were unfavourably influenced by the difficulties in the way of controlling their results and realized the impossibility of appreciably increasing our knowledge in the absence of such controls. Be this as it may, the difficulties in the way of experimental research have unfortunately brought extremists to the fore, and such statements as the following are scattered throughout the literature. "The whole trend of recent inquiry and the results of clinical experiment have been to show that at the present day more than ever before, the scientific administration of quinine is established as a measure of very great value and that it is indispensable in the general prevention of the disease."⁴ "Quinine has its position in relief and cure, but in sanitary administration it has none."⁵

⁴ Brown, W. Carnegie, *Trans. Soc. Trop. Med. and Hyg.*, London, iv, p. 193.

⁵ Macdonald, A., *Trans. Soc. Trop. Med. and Hyg.*, London, x, p. 1.

In such controversial subjects as the one under discussion, when extreme views are expressed in the absence of adequate evidence, the truth usually lies between the two extremes. Knowing as we do that resistance to malarial disease is considerably greater in the inhabitants of malarial countries than it is in immigrants from non-malarial ones, it would seem natural to suppose that, other things being equal, *the benefit derived from the use of prophylactic quinine varies directly as the resistance of the individual taking it*—in other words, the greater the resistance the better the statistics.

The truth of this theory can only be tested in the present state of our knowledge by analysing the statistical evidence from different countries, taking care to differentiate between the natives of such countries and immigrants.

This has been accordingly done in Tables V to VIII.

Analysis of Statistical Evidence from 1880 to Present Time.

TABLE V.—COUNTRIES BORDERING ON MEDITERRANEAN BASIN.

		In favour of quinine		In favour of quinine with reservations		Against		Total
Statistics but no controls	..	16	..	0	..	1	..	17
Statistics with controls	..	18	..	0	..	0	..	18
		—		—		—		—
Total	..	34	..	0	..	1	..	35

All thirty-four papers in favour of quinine prophylaxis deal with the question in so far as it affects the permanent inhabitants of the respective countries; the single paper against deals with temporary inhabitants, viz., the French Army in Macedonia.

TABLE VI.—AFRICA, EXCLUDING THE MEDITERRANEAN AREA.

		In favour of quinine		In favour of quinine with reservations		Against		Total
Statistics but no controls	..	13	..	1	..	3	..	17
Statistics with controls	..	2	..	0	..	2	..	4
		—		—		—		—
		15	..	1	..	5	..	21

One of the four papers in which controls were used deals with natives and is in favour of quinine prophylaxis; the remaining three deal with immigrant whites—one paper being in favour and two against.

TABLE VII.—SOUTHERN ASIA.

		In favour of quinine		In favour of quinine with reservations		Against		Total
Statistics but no controls	..	14	..	1	..	6	..	21
Statistics with controls	..	5	..	0	..	4	..	9
		—		—		—		—
		19		1		10	..	30

Three out of the nine papers in which controls were used deal with natives and are in favour of quinine prophylaxis. The remaining six deal

either with immigrants or with partly immigrant populations such as coolies on rubber plantations; two were in favour of quinine prophylaxis, four against.

TABLE VIII.—NORTH AND SOUTH AMERICA, INCLUDING WEST INDIES.

		In favour of quinine		In favour of quinine with reservations		Against		Total
Statistics but no controls ..	..	3	..	3	..	1	..	7
Statistics with controls ..	..	1	..	0	..	2	..	3
Total ..	..	4	..	3	..	3	..	10

One out of the three papers in which controls were used deals with natives and is in favour of quinine prophylaxis; the other two deal with immigrants and are against.

A study of these tables reveals the existence of a state of affairs very different to what might have been anticipated from merely glancing over the opinions of the various writers summarized in Table IV, especially when we remember that *controlled results are the only results of any scientific value*. When controls were used and natives of the respective countries investigated, no less than twenty-three or 100 per cent of workers were in favour of prophylactic quinine. When controls were used and immigrants dealt with, only three out of eleven or 27·2 per cent were in its favour. The evidence available would therefore seem to justify the enunciation of the following law: "*Other things being equal, the natives of malarial districts derive more benefit from quinine prophylaxis than immigrants from non-malarial ones.*"

Let us now attempt to estimate the real value of quinine prophylaxis to the natives of such districts.

An attempt to estimate the real value of prophylactic quinine to the natives of malarial countries in the Mediterranean Area.—We have seen that all the available statistical evidence is in favour of administering prophylactic quinine to the inhabitants of Mediterranean districts in which malaria is endemic. What does this really amount to? Celli, one of the best known of the Italian workers, thus expresses himself: "The daily use of quinine is as necessary as daily bread during certain months."⁶ "He who takes quinine every day and therefore has always a supply of quinine in the blood-stream, can undergo with impunity inoculations of blood full of malarial parasites and can expose himself with little or no danger to the bites of infected mosquitoes."⁷ One might almost conclude from this that the Italian with a little quinine in his pocket was in a position to snap his fingers at malaria under the most unfavourable conditions. Yet a little later the following analysis of very extensive clinical material was published by the same author⁸:—

⁶ Celli, A., *Journ. Trop. Med.*, London, 1908, xi, 101.

⁷ Celli, cited by Henson, "Malaria," Henry Kimpton, 1918, 136.

⁸ Celli, cited by Stuart (M.), *Proc. Canal Zone. Med. Assoc.* for the half year, 1910, 67.

N.B.—This Table is reproduced by several authors.

TABLE IX. (TAKEN FROM CELLI).

Mosquito prophylaxis + quinine prophylaxis	..	..	..	Symptoms in 1.75 per cent of cases or 1 in 57				
Mosquito prophylaxis only	..	..	..	"	2.5	"	"	1 .. 40
Quinine prophylaxis only	..	..	..	"	20	"	"	1 .. 5
No protection	..	..	..	"	33	"	"	1 .. 3

Clearly the quinine given produced some effect, but compared with the results obtained by mosquito prophylaxis, its action was almost negligible.

The brothers Sergent, who have investigated the subject for many years in Algeria, seem less enthusiastic than they used to be. The last paper I have seen gives details of the quinine given to native children in 1910.⁹ One of their tables is reproduced, and the authors content themselves with the observation that all methods give appreciable results:

TABLE X.—TAKEN FROM SERGENT (E. AND E.).

Dose of quinine	Improvement	No change	Worse
0.2 grm. daily	19 (5.5 per cent)	315 (83.5 per cent)	7 (2.02 per cent)
0.6 " every three days	19 (4.2 ")	425 (94.6 ")	4 (0.9 ")
0.6 " every six days ..	35 (9.7 ")	300 (80.4 ")	16 (4.8 ")
Controls (no quinine) ..	5 (0.8 ")	220 (90.5 ")	21 (8.7 ")

These Italian and North African results are not very impressive, especially when it be remembered that we are dealing with the only type of case in which a consideration of the general statistical evidence led us to suppose that really striking benefit would be uniformly attained, viz., natives who have presumably inherited and acquired a certain amount of immunity against the parasites of their own country.

(b) THE DIFFERENT METHODS OF GIVING PROPHYLACTIC QUININE.

The following are the two methods usually employed:—

(1) A small daily dose—five grains, for example.

(2) A larger quantity—usually fifteen grains, taken on two consecutive days at intervals of from a week to ten days.

The advocates of method No. 1 claim that quinine taken in this way is always circulating in the blood, and object to No. 2 because it leaves the individual defenceless for several days owing to the rapid excretion of the quinine absorbed.

The partisans of method No. 2 maintain that by giving quinine in this manner the curative effect of the drug is not interfered with, but that the use of No. 1 may lead to the production of quinine-proof strains of parasites. I have searched the literature but can find no evidence of one method having any appreciable advantage over the other.

It is interesting to note that in Italy, Greece, and North Africa, three

⁹ Sergent, E. and E., *Ann. de l'Inst. Pasteur*, Paris, 1913, xxvii, p. 872.

to six grains daily is the ordinary dose employed, and larger quantities are not usually supposed to give any better results. On referring to Table III we notice that, on the whole, the smallest percentage of cases was diagnosed in those who were taking least quinine. The possible significance of these facts will be considered later.

(c) THE RÔLE OF SUGGESTION IN QUININE PROPHYLAXIS.

In quinine prophylaxis, as in all forms of medical treatment, the personality of the physician is not without influence, while the extent of his confidence in the treatment proposed can usually be gauged by the patient with considerable accuracy. These considerations explain to some extent the ephemeral success of many new drugs and methods of treatment. Traces of a similar process can be found in the history of quinine prophylaxis. Laveran,¹⁰ for example, in his book on malaria, published in 1898, comments on the fact that the English, who previously wrote so much in favour of prophylactic quinine, seem to have got tired of it.

The psychological aspect of malaria prophylaxis has received considerable attention from American writers, several of whom regard the co-operation of the public as essential, and agree that no means of stimulating its curiosity and of keeping its sympathy should be neglected.^{11 and 12}

In Macedonia the French authorities advertise the merits of quinine by means of humorous coloured posters and picture post cards, which must go far towards reconciling the "poilu" to his daily dose. In Algeria the brothers Sergent have initiated the use of pink tablets containing three parts of sugar and two of quinine bihydrochloride, and state that these are everywhere accepted by the natives with the greatest alacrity, in marked contradistinction to their attitude towards the classical method.

These things are really worth bearing in mind, and the striking possibilities of suggestion are vividly brought home to one by the following incident, related in all seriousness by Henrot.¹³ "Dr. Nouat, head of the Military Hospital, Calcutta, was consulted by the Governor of Bengal as to the best way of protecting messengers against malaria. So many died from pernicious malaria as a result of the unhealthy country they had to cross, that messengers had become unobtainable. Dr. Nouat, acting on a theory prevalent at the time—that infection took place via the respiratory tract—constructed respirators containing finely divided animal charcoal, and made the messengers wear them; the effect was excellent, for the messengers, although taking exactly the same route as their predecessors, ceased being ill."

¹⁰ Laveran, *Traité du Paludisme*, 1898.

¹¹ Henson, G. E., *New York Med. Journ.*, 1910, xcii, p. 724.

¹² Craig, C. F., *South Med. Journ.*, Nashville, 1911, iv, pp. 469, 478.

¹³ Henrot, H., *Bull. Acad. de Méd.*, Paris, 1895, xxxiv, pp. 292, 325.

(d) CONCLUSIONS AS TO THE EFFECT OF QUININE IN PREVENTING CLINICAL MALARIA IN MACEDONIA.

(1) *Primary Malaria*.—We saw in Table I that a proportion of the men exposed to the risk of infection escaped, evidently because—(a) They had never been bitten by infected mosquitoes, or (b) if infected, their powers of resistance were equal to the occasion and no clinical symptoms ensued.

To what extent had the natural resistance of these latter been reinforced by taking quinine?

Although the drug must have been the decisive factor in a few cases, the previously considered evidence points to their number having been very limited. No matter what disease we take, a proportion of any population is always more or less refractory. Moreover, malaria may be a very chronic condition, and the presence of parasites in the blood of people who have never developed symptoms, and who have never taken quinine, is perfectly well known. As Bass¹⁴ says: "No doubt many people get infected without ever knowing anything about it; others infected under similar conditions may be ill and in some cases die." Further, the absence of symptoms in such apyrexial carriers is no guarantee of permanent immunity; in many cases all that is needed to produce an attack is such slight lowering of vitality as is produced for example by a chill, a surgical operation, or a broken bone.

(2) *Recurrent Malaria*.—I have come across no evidence which leads me to suppose that quinine is any more efficient in preventing relapse than it is in aborting the initial attack (*vide* Tables II and III).

II.—*Is the general course of the disease ever affected by previous quinine prophylaxis? If so, is the sum of such influences favourable or the reverse?*

The matter will be discussed under the following headings:—

- (a) The clinical evidence and its significance.
- (b) The mode of action of quinine in malaria both as a prophylactic and as a curative agent.
- (c) Conclusions.

(a) THE CLINICAL EVIDENCE AND ITS SIGNIFICANCE.

The following examples are taken from the literature of the subject:—

(1) Celli states that both doctors and patients are unanimous that daily prophylactic quinine very frequently aborts primary infections, notably diminishes relapses, and prevents cachexia.¹⁵

(2) So far back as the American Civil War the responsible medical authorities¹⁶ state that men were saved from attack and preserved in perfect health for the time being by the use of prophylactic quinine, but

¹⁴ Bass, C. C., *Kentucky Med. Journ.*, Bowling Green, 1917, p. 393.

¹⁵ Celli, A., *Journ. Trop. Med.* London, 1908, xi, p. 101.

¹⁶ "The Medical and Surgical History of the War of the Rebellion," 1888. iii, 165.

that the method was abandoned owing to the shortage of quinine and to the eventual sickness of such men.

(3) Neiva (Brazil) who was in charge of 3,000 men in a highly malarial district found that to obtain the same therapeutic effect, the dose of quinine had to be increased in proportion to the length of exposure to infection.¹⁷

(4) Bell (Panama) states that men who were receiving the drug, in comparison with those who were not, under otherwise identical conditions, furnished fewer cases in the proportion of three to four; that such men were, however, more refractory to treatment, had a more prolonged convalescence and relapsed more frequently.¹⁸

(5) Stitt¹⁹ is of the opinion that quinine in reasonable doses has little or no effect, while those who take it are less amenable to its curative action and relapse more frequently than those who only take the drug at the time of an attack; he also maintains that quinine prophylaxis does not prevent either anæmia or splenic enlargement, while Jacobson²⁰ goes so far as to say that although symptoms may be masked for a time, the actual damage is as great as though no quinine had been given.

(6) We have seen that in Macedonia quinine alone is quite unable to prevent malaria, while very large doses have to be given in many cases to obtain clinical amelioration. Only a few weeks ago at a meeting of the Society of Tropical Medicine and Hygiene, a paper was read by Sir Ronald Ross in which details were given of various intensive forms of quinine treatment in chronic cases of malaria invalidated from Macedonia. No matter how big the dose or what route was chosen for its administration, frequent relapses still occurred.

Comment: After studying this and similar evidence, we are bound to admit that the general course of the disease may be adversely influenced by the previous taking of quinine. How is such a thing possible and why do different observers get such remarkably discordant results? The answer to the last question will be considered first.

Why does Quinine give such Variable Clinical Results?—Under ordinary circumstances the key to the problem undoubtedly lies in the constitution of the patient and in his state of health both at the time of infection and subsequently. We know that under good social conditions intermittent malaria tends to cure itself both temporarily and permanently, and that whether quinine be given or not, the temperature returns to normal in a few days. If only a little outside help is required to change the balance in favour of the patient, good hygienic conditions, an enthusi-

¹⁷ Neiva. Cited by Hudleston, *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, London, 1913, xxi, 320.

¹⁸ Bell. Cited by McGuire, *U.S. Nav. Med. Bull.*, 1914, viii, p. 571.

¹⁹ Stitt, E. R., *Journ. Amer. Med. Assoc.*, Chicago, 1908, i, 1682.

²⁰ Jacobson, A. C., *New York Med. Journ.*, 1906, lxxxiv, p. 1224.

astic physician, and a little quinine will suffice either to definitely cure the individual, or at any rate to prevent his relapsing for a considerable time in the absence of reinfection. If on the other hand the resistance of the patient falls short of this, no marked benefit will result.

We have just seen that clinical evidence favours the view that the course of malaria may be unfavourably affected by the previous taking of quinine. How can this occur and what is the mechanism of the process?

Discussion of the Probable Mechanism.—We have seen that under relatively favourable conditions a small daily dose of quinine tends to prevent clinical malaria or at all events to lengthen the incubation period. This, however, cuts both ways, and should an individual run the risk of being frequently infected, the tendency will be for him to receive more massive doses of sporozoites as the result of taking prophylactic quinine. Can we wonder if his malaria is of a severer type when it does develop? It is universally assumed that the sporozoites resulting from conjugation in the insect host possess a greater potential capacity for mischief in the vertebrate host than merozoites derived from many generations of asexual multiplication. We know that a European in the Tropics who stays out at night and is generally careless with regard to mosquito prophylaxis is much more likely to suffer from and to be eventually invalidated home with chronic malaria than the individual who is careful in these respects. Even experimental evidence is not altogether wanting, for experiments on proteosoma infections in sparrows are said to show that the severity of the disease largely depends on the dose, that is to say on the number of sporozoites inoculated.²¹

We are now in a position to appreciate the inadvisability of giving prophylactic quinine over long periods, and to realize that the severity of malaria in Macedonia has been undoubtedly increased in some cases by previous quinine prophylaxis.

(b) THE PROBABLE MODE OF ACTION OF QUININE IN MALARIA.

(1) *As a Prophylactic.*—"Quinine differs from most other important alkaloids in acting not on some specialized form of living matter, but on the general nutrition of almost all forms of protoplasm. Experimental evidence indicates that a number of ferments act more vigorously in very dilute solutions of quinine, while their action is retarded by larger quantities."²² It is possible, therefore, that the lytic action of human plasma on malarial parasites is increased when quinine is present in suitable concentration. It is equally possible that too great a concentration of quinine retards this activity; also that the long continued administration of the drug sets up a tolerance to its presence which necessitates an increase of concentration to get the original effect.

²¹ Gill, C. A., *Indian Journ. Med. Research*, 1914, ii, p. 268.

²² Cushny, "Pharmacology and Therapeutics," 1915.

We have previously noted that certain doctors in Mediterranean countries regard 0·2 gramme (about three grains) daily as sufficient; also that the few cases I had the opportunity of examining in Macedonia appeared to justify the view that a maximum daily dose for prophylactic quinine exists and that it is not a very big one. It is also possible that the mechanism about to be considered is not without influence.

(2) *The Action of Quinine as a Curative Agent.*—Barlow, as the result of experimental work, thinks that quinine in therapeutic doses does not directly destroy the plasmodium, but tends to poison infected red blood corpuscles in such a way that they are more easily acted upon by the excretory products of the parasite. This results in its liberation before segmentation has taken place and facilitates its destruction. Gametes escape because their less active metabolism does not liberate sufficient toxin to destroy even the quinine-poisoned cell.²³

Comment.—This explanation is in harmony with the facts. We know, for example, that quinine given at the beginning of an attack of intermittent malaria, does not appreciably influence the train of clinical events but tends to prevent subsequent attacks. It would seem to do this by poisoning infected red corpuscles and accelerating their disintegration, thus making the conditions less favourable for the multiplication of the parasite, which is unlikely to be present in sufficient numbers to produce symptoms when the next attack is due. The functioning of this mechanism would evidently give the resisting powers of the individual time to rally. Should his vitality be insufficient to dispose of all the plasmodia the metabolism of the survivors may be assumed to slow down, and even very large doses of quinine may be unable to poison the red cells sufficiently for the parasitic toxins to destroy them with sufficient speed, the plasmodium reacting by slowing its metabolism still further. In many cases it successfully avoids extermination, and in the event of the host's vitality being sufficiently lowered a relapse occurs.

In severe and chronic cases resulting either from massive infection or from the feeble resisting power of the individual or from a combination of the two, large doses of quinine are usually given over long periods; according to the above theory the poor results obtained would be largely due to an increased tolerance of the red cells for quinine.

(c) CONCLUSIONS.

Both clinical and theoretical considerations compel us to admit that the general course of the disease may be noticeably affected by the previous taking of quinine, and that the sum of such influences is frequently unfavourable. So far as the Allied Armies in Macedonia are concerned, there is every reason to suppose that quinine taken daily over

²³ Barlow, *Amer. Journ. Trop. Dis. and Prev. Med.*, 1915, ii, p. 585.

periods of many months has increased the severity and chronicity of the disease in a certain proportion of cases. Taking one thing with another the available evidence indicates that, in Macedonia at any rate, the disadvantages of quinine prophylaxis outweigh the advantages.

GENERAL SUMMARY OF CONCLUSIONS.

(1) Small doses of prophylactic quinine, not too long continued, are of proved utility to the natives of malarial countries, both in the absence of anti-mosquito measures, and when such measures are incomplete.

(2) Quinine may be given with advantage to immigrants under the following conditions: (a) During short journeys when conditions with regard to mosquito prophylaxis are less favourable than usual. (b) An occasional dose after an unusually tiring day. (c) Nervous people may be advised to take an occasional course as an additional precaution in spite of efficient mosquito prophylaxis.

Speaking generally, it may be stated that quinine prophylaxis is usually a bad investment for immigrants in the absence of protection against mosquito bites; taking one thing with another, the practice would in their case seem to be little more than a pious fraud which has been perpetuated from one generation to the next, simply because public opinion throughout the world has never been sufficiently enlightened to encourage the working out of the problem on scientific lines. A few well planned experiments, carefully and simultaneously conducted in several countries, and these conclusions might have been reached many years ago. We know the experimental method to be at the bottom of all scientific and industrial progress, yet we refuse to admit its very obvious utility in Preventive Medicine. The following observation applies only too literally to the subject under discussion: "En dehors des sujets dont le contrôle expérimentale est facile, bien peu d'opinions s'appuient sur la logique rationnelle. Sur l'interprétation de faits au fond assez clairs, mais que n'étaient pas des expériences suffisamment tangibles, le désaccord est complet."²⁴ Surely this lamentable state of affairs cannot continue much longer? The experimental evidence exists, but unfortunately its neglected fragments lie embedded in a very extensive literature, much of which is of little value owing to lack of detail and to the impressions of the writers being uncontrolled by clinical experiment.

APPENDIX.

Although the difficulties in the way of efficient mosquito prophylaxis in non-immune armies operating in highly malarial countries are undoubtedly very great, the failure of quinine prophylaxis shows that more serious efforts will have to be made in order to overcome them. A few methods of procedure are therefore mentioned and their value briefly discussed.

²⁴ Le Bon, C., "Premières Conséquences de la Guerre," 1916.

A.—THE DESTRUCTION OF MOSQUITO LARVÆ.

(1) *Subsoil Drainage*.—Everyone agrees that this is the ideal method. Unfortunately finance and labour difficulties militate against its general adoption. In Panama, where both money and labour were available, this method was little used, owing to the engineering works constantly interfering with the drains.²⁵

(2) *The Oiling of Surface Water*.—In Panama, the system of oiling seems to have been perfect, the whole area for about half a mile round all dwelling places being oiled once a week so thoroughly that all mosquito larvæ were killed.²⁶ The method is obviously a good one when sufficient oil can be obtained.

(3) *The Piping of Streams*.—In ravine country when mosquitoes breed in the pools associated with fast running but temporary streams, such streams may be piped with advantage within half a mile of camps.

B.—MECHANICAL PROPHYLAXIS AGAINST MOSQUITO BITES.

In countries where the reduction of mosquito larvæ is difficult, the importance of mechanical prophylaxis can hardly be exaggerated. The question will be briefly considered under the following headings.

(1) *The Screening of Dwellings*.—In the Canal Zone, all houses occupied by Americans had double doors, the windows being protected with copper-bronze screens, eighteen mesh to the inch. Crenstein²⁶ concludes that properly screened dwellings alone can be depended upon to reduce by at least one-third the malaria incidence in a locality where malaria is endemic.

(2) *Net Prophylaxis*.—Stott²⁷ and others have emphasized the great value of supervised net prophylaxis for soldiers.

(3) *Veils and Gloves with Gauntlets*.—These have been employed on sentry duty, etc. If properly used such methods should be fairly effective, but adequate supervision is obviously difficult or impossible.

(4) *Essential Oils*.—Oil of citronella, etc., either pure or in the form of ointment, has been tried for men on night duty, but without much success. According to Celli and others such methods have a very restricted action.

(5) The employment of African or Greek troops for sentry duty and all forms of night work during the summer and autumn months would seem to be worthy of serious consideration. After going carefully into the matter, the advantages might be found to outweigh the disadvantages.

(6) The last but certainly not least important method is the education of officers and men as to the habits of the mosquito, and the means of avoiding infection. Pamphlets, posters, lectures, lantern slides, cinema films, all have their place according to circumstance and opportunity.

In conclusion I should like to thank my brother, Captain H. A. Treadgold, R.A.M.C., for valuable assistance.

²⁵ Watson, M., *Med. Press and Circ.*, London, 1913, xcvi, 552.

²⁶ Crenstein, A. J., *Journ. Amer. Med. Assoc.*, Chicago, 1914, lxiii, 1931.

²⁷ Stott, H., *Indian Med. Gaz.*, Calcutta, 1915, i, p. 382.

REFERENCES.

- [1]—1888.—BIZARDEL, cited by LAVERAN. *Traité de Paludisme*, 1898.
- [2] „ GROESER. *Berl. klin. Wochenschr.*, xlii, p. 53.
- [3]—1890.—CLAVELLE, cited by NAVARRE. *Lyon Méd.*, 1896, lxxxi, p. 563.
- [4] „ GLEIZE, cited by LANEL. *Arch. de Méd. Militaire*, December, p. 464.
- [5] „ MAZEILLI. *Ibid.*
- [6] „ ALVERNTE. *Ibid.*
- [7]—1891.—MOIR, D. M. *Indian Med. Gazette*, Calcutta, xxvi, p. 33.
- [8]—1893.—BARTHOLÉMY, cited by LAVERAN, 1898.
- [9]—1895.—QUENNEC. *Ibid.*
- * [10] „ DUNCAN, A. *Indian Med. Gazette*, Calcutta, xxx, p. 98.
- * [11] „ HARVEY, cited by DUNCAN, 1895.
- * [12] „ PARKE. *Ibid.*, *Brit. Med. Journ.*, London, 1900, ii, p. 529.
- * [13] „ BONNEFOY, cited by FRUITET. *Arch. de Méd. Militaire*, 1896, i, p. 5.
- [14]—1896.—THIN, G. *Lancet*, London, i, p. 219.
- [15] „ RAY. *Arch. de Méd. Militaire*, ii, p. 367.
- [16] „ FRUITET. *Ibid.*, i, p. 5.
- [17] „ SAINT MACARY, cited by LAVERAN, 1898.
- [18] „ LE MOIVAL, cited by NAVARRE, 1896.
- [19]—1898.—BUCHANAN W. J., *Journ. Trop. Med.*, London, i, p. 201.
- * [20]—1901.—MOBI, A. *Centralbl. f. Bakt.*, etc., Jena, xxix, p. 786.
- [21] „ MICHON, cited by LEGER, 1913.
- [22] „ VAN CAPBOUT, cited by MICHON, 1903.
- [23]—1903.—MICHON, J. *Bull. Acad. de Méd.*, Paris, xlix, p. 672.
- [24] „ FERNANDO, H. M. *Brit. Med. Journ.*, London, ii, p. 713.
- [25]—1904.—BERG. *Arch. f. Schiffs. u. Tropenhyg.*, Leipzig, viii, p. 329.
- [26] „ WENDLAND. *Ibid.*, viii, p. 431.
- * [27] „ ZIEMANN. *Ibid.*, viii, p. 329.
- [28] „ BERINGER. *Journ. Trop. Med.*, London, vii, p. 255.
- [29] „ SOULS. *Arch. de Méd. Nav.*, Paris, lxxxi, p. 81.
- [30] „ LENZ. *Arch. f. Hyg.*, München u. Berlin, xlviii, p. 322.
- [31] „ PRESSAT, A. *Presse Méd.*, Paris, ii, p. 482.
- * [32]—1905.—BABES. *Münch. med. Wochenschr.*, April 4.
- * [33] „ HINTZE, R. *Arch. f. Schiffs. u. Tropenhyg.*, Leipzig, ix, p. 97.
- [34] „ MEIXNER and KUDICHE. *Ibid.*, ix, p. 479.
- * [35] „ TECCI, cited by CELLI, A. *Arch. f. Hyg.*, München u. Berlin, 1905, p. 83.
- * [36] „ ANDRETTA, *idem.* *Ibid.*
- * [37] „ DECHIARA. *Ibid.*
- * [38] „ TANZARELLA. *Ibid.*
- * [39] „ OMIZZOLO. *Ibid.*
- * [40] „ AMBROSI. *Ibid.*
- * [41] „ POSTEMPSKY. *Ibid.*
- * [42] „ MARIANI. *Ibid.*
- * [43] „ LABBANCA. *Ibid.*
- * [44] „ NICASTRO. *Ibid.*
- [45] „ BERTARELLI. *bid.*
- [46] „ GUALDI. *Ibid.*
- [47] „ ROSINELLI. *Ibid.*
- [48] „ FORTUNATO. *Ibid.*
- * [49] „ BRIGNONE, E., and ALZONA, V. C. *Atti. d. Soc. p. g. Studi d. Malaria*, vii, p. 219.
- [50]—1907.—BROQUET. *Ann. d'hyg. et de méd. Colon.*, Paris, x, p. 257.
- [51] „ TREHERNE, F. H. JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, London, ix, p. 276.
- [52]—1908.—WATSON, M. *Brit. Med. Journ.*, London, i, p. 449.
- [53] „ CHAGAS, C. *Zeitschr. f. Hyg. u. Infektionskrankh.*, Leipzig, lx, p. 321.
- [54] „ SPITT, E. R. *Journ. Amer. Med. Assoc.*, Chicago, i, p. 1682.
- [55] „ BENTMANN. *Arch. f. Schiffs. u. Tropenhyg.*, Leipzig, xii, p. 640.

- [56]—1908.—SEADLER, cited by RUGE. *Journ. State Med.*, 1913, xxi, p. 564.
- [57] „ “H.M.S. Panther,” *idem. Ibid.*
- * [58] „ CARDAMATIS and HADJIMICHALIS. *Ann. Trop. Med. and Parasitol.*, ii, p. 133.
- * [59] „ SERGENT, E. and É. *Ann. de l'Inst. Past.*, Paris, xxii, 390.
- [60]—1909.—ZUR VERHE. *Arch. f. Schiffs. u. Tropenhyg.*, Leipzig, xiii, p. 174.
- [61] „ KUHN, R. *Ibid.*, p. 185.
- [62] „ PERMA, J. *Bull. de l'Office international. d'hyg.*, Paris, i, p. 133.
- [63] „ BOUFFARD. *Bull. Soc. path. exot.*, Paris, ii, pp. 34 and 84.
- * [64]—1910.—SCHILLING, cited by ROSS. “Prevention of Malaria,” 1910.
- * [65] „ CELLI, *idem. Ibid.*
- [66] „ HENSON, G. E. *New York Med. Journ.*, xcii, p. 724.
- [67] „ STUART, M. *Proc. Canal Zone Med. Assoc.*, 1910, p. 61.
- * [68] „ SAVAS. *Atti. d. Soc. p. g. Studi d. Malaria*, Roma, xi, p. 121.
- * [69] „ BELL, cited by McGUIRE, 1914.
- * [70]—1911.—LELEAN, P. S. *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, London, xvii, p. 463.
- [71] „ OZZARD, *Trans. Soc. Trop. Med. and Hyg.*, London, iv, p. 201.
- * [72] „ WATSON, M. “The Prevention of Malaria in the Federated Malay States,” Liverpool School of Tropical Medicine.
- [73]—1912.—LUSTIG, A. *Munch. med. Wochenschr.*, lix, p. 2053.
- [74] „ BISDOM, W. *Janus*, xvii, p. 400.
- [75] „ HILLEL YOFFÉ. *Rev. de Méd. et d'Hyg. Trop.*, Paris, ix, p. 22.
- * [76] „ RYLEY, cited by HUDLESTON, W. E. *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, London, 1913, xxi, p. 320.
- [77]—1913.—GREEN, cited by HUDLESTON. *Ibid.*
- [78] „ BYAM, cited by HUDLESTON. *Ibid.*
- * [79] „ NEIVA, cited by HUDLESTON. *Ibid.*
- [80] „ MACGILCHRIST, A. C. *Indian Journ. Med. Research*, Calcutta, i, p. 339.
- [81] „ ENGELAND, O. *Arch. f. Schiffs. u. Tropenhyg.*, xvii, p. 523.
- [82] „ RIEUX, J., and HORNUS, P. *Arch. de Méd. et de Pharmacie Militaire*, lxii, p. 1.
- * [83] „ LEGER, M. *Ann. de l'Inst. Past.*, Paris, xxvii, p. 765.
- * [84] „ THOMSON, H. N. *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, London, xxi, p. 368.
- * [85] „ GRAHAM, J. D. *Journ. Trop. Med. and Hyg.*, London, xvi, p. 368.
- [86] „ MOSZKOWSKI, cited by RUGE. *Journ. State Med.*, xxi, p. 564.
- [87]—1914.—FISCH, R. *Arch. f. Schiffs. u. Tropenhyg.*, Leipzig, xviii, p. 117.
- [88] „ HATORI, J. *Ann. Trop. Med. and Parasitol.*, Liverpool, viii, p. 537.
- * [89] „ STOTT, H. *Indian Med. Gazette*, Calcutta, xlix, p. 462: 1915, i, pp. 47, 85, 131, 172, 213.
- * [90] „ McGUIRE, L. W. *U.S. Nav. Med. Bull.*, Washington, viii, p. 571.
- [91]—1915.—CARTER, H. R. “Malaria, Lessons of its Cause and Prevention.” Government Printing Office, Washington.
- [92] „ PARROT. “Malaria, etc.,” Roma, vi, p. 14.
- [93] „ LINNEL, R. M. C. *Trans. Soc. Trop. Med. and Hyg.*, London, viii, p. 239.
- [94]—1917.—ABRAMI, P. *Press Méd.*, March 22.
- [95] „ CIAVALDINI. *Ann. de l'Inst. Past. d'Algérie*, April.

¹ (1) All these writers give some account of their experience with prophylactic quinine.

(2) The names of workers who attempted to control their results are marked with an asterisk.

(3) All reference to literature which merely expresses the personal opinion of the author without giving details of his work is omitted.

"MYALGIA"—ITS DIAGNOSIS IN FORWARD AREAS.

By CAPTAIN FRANCIS B. CHAVASSE.

Royal Army Medical Corps.

INTRODUCTORY.

THE term "myalgia," originally introduced in order to rescue a certain class of case from the heading "rheumatism," shows a tendency under the conditions of diagnosis which obtain in forward areas to be expanded so as to hold almost as much as the term "rheumatism" itself.

In view of the importance of accurate diagnosis in these cases, both from the point of view of treatment, and from the point of view of economy in man power—that a man may be allocated early to work suited to his physical powers— inquiry was made to ascertain the extent and the directions in which it might be possible to improve the diagnosis "myalgia" (as generally made) by the application of simple and rapid criteria suitable to the difficulties which attend diagnosis in the front line.

And further, inquiry was made into the leading symptoms of myalgia as seen by the Regimental Medical Officer, in order to provide a basis on which, after the exclusion of conditions likely to be confounded with it, the diagnosis "myalgia" might rapidly and reasonably be made, and (an important point) the severity of the case adjudicated.

The importance of accurate diagnosis at the outset of a patient's journey towards rear areas is enhanced by the great weight which any diagnosis once made carries with it: and the reluctance of a Medical Officer in a rear area to change the diagnosis—forgetful of the fact that it may have been made in a shell hole. And another reason why the diagnosis "myalgia" is seldom corrected is that myalgia, by reason of the intangibility of its symptoms and the opportunity it affords to malingerers, has got a bad name, and is generally regarded as a nuisance rather than as a problem.

The observations (an account of which follows) were conducted at a field ambulance over a period of three months, and with a front line battalion over a period of twelve months. A few cases necessary to complete the series were seen at a casualty clearing station.

I.—DIFFERENTIAL DIAGNOSIS.

The application of the rough and rapid diagnostic criteria shown below to 200 cases reaching field ambulance and casualty clearing station diagnosed "myalgia" resulted in an improvement of the diagnosis in 60 cases excluding those newly diagnosed "neuralgia," and in 108 cases including the new diagnosis "neuralgia" (i.e., in more than one half), as shown in the following table:—

Pyrexial Conditions.—(P.O.U.O., etc.) (19 cases = 9·5 per cent). In almost all cases the pyrexia was in the evening only. It is noticeable, especially in winter and when for any reason it is difficult to keep the

troops warm, that a patient may have an evening temperature as high as 102° F., and yet be subnormal at the sick parade early next morning. Hence the pyrexial nature of the condition is easily overlooked, unless there is an unofficial evening sick parade or some such arrangement.

TABLE SHOWING THE RESULT OF AN ATTEMPT TO IMPROVE THE DIAGNOSIS IN 200 CASES
DIAGNOSED "MYALGIA."

New diagnosis	Criteria applied	Number of cases
Pyrexial conditions	Pyrexia (usually evening only)	19
Post-pyrexial conditions :	History of "P.O.U.O.," or trench fever, within previous five weeks with more or less continuous pain since	—
Neuralgia*	Pain, aggravated when patient is lying down, warm, and perfectly still	12
Ostalgia*	Ditto; tenderness over shins	5
Unspecified	Pain on movement; stiffness aggravated after rest ..	2
		— 19
Arthritis :	Creaking	0
Osteo-arthritis	Palpable bony deformity	3
Rheumatoid arthritis ..	Peri-articular infiltration	6
Unspecified .. ..	.. .. .	7
		— 16
Sciatica	Kernig's sign; nerve tenderness	4
Neuralgia†	Pain, aggravated when patient is lying down, warm, and perfectly motionless	46
Muscular stiffness following considerable exertion	History	2
Gout	Joint signs	1
Muscular cramps	History	1
	Total	108

* Usually accompanied by pain on movement.

† Previous history of "P.O.U.O.," or "trench fever," in twenty-one cases, occurring from five weeks to one year previously.

Post-pyrexial Conditions.—(19 cases = 9·5 per cent). In the majority of cases the patient was able to state that he had been in hospital a short time (within five weeks) previously and that "it said P.O.U.O. on the card." (Patients appear to take a most painstaking interest in their cards). In a few cases only the pyrexial nature of the forerunning illness had to be judged by the patient's history of his symptoms—headache, sweating, etc.

The predominant features of these post-pyrexial pains are: (1) That they are present in an aggravated degree when the patient is warm in bed and lying motionless; and (2) that they are referred to the shin bones in many cases, there being in a few cases actual tenderness of the subcutaneous surface of the tibia. True myalgic pains, in marked contrast to this, are absent at complete rest but aggravated after rest, until the stiffness which has increased during rest has worked off.

Pyrexial and post-pyrexial conditions (nineteen cases each) thus account for thirty-eight of the 108 cases in which the diagnosis "myalgia" was susceptible of improvement. The importance of the alteration is seen

as soon as the question of treatment is raised; the treatment of myalgia by massage, liniments, Turkish baths, etc., being definitely contra-indicated in pyrexial conditions, and hardly the best for post-pyrexial neuralgia and ostalgia in which delayed convalescence seems to be the main factor.

Arthritis.—(16 cases = 8 per cent) (osteo-arthritis 1·5 per cent, rheumatoid arthritis 3 per cent, unspecified 3·5 per cent). The joints affected were mainly knees. A few shoulders were included in the series and one hip. The preponderance of knees is probably largely due to easy diagnosis. There is no doubt that a skilled diagnostician, especially if unhampered by time, would be able to take many more cases—especially shoulders, hips and spines—out of the myalgic abyss.

The figures are considerable enough in themselves, and become more so in view of the fact that the patients were drawn almost exclusively from what in Germany would be termed a "shock" division, and included few above forty years of age. The arthritis figures for labour battalions and so on would naturally be very much higher.

The importance of detecting the cases is economical. No treatment for "myalgia" makes them fit for winter work in the trenches. They are a burden to field ambulances and to hospitals, and are only a paper asset to their Division. But once the condition is recognized there is some chance that suitable employment may be found for the case.

Sciatica.—(4 cases = 2 per cent). The diagnosis is important from the point of view of treatment; adequate treatment of recurring sciatica being unobtainable at a field ambulance. Occasionally the rough diagnosis "sciatica" is made where "myalgia" would be nearer the mark.

Neuralgia.—(46 cases = 23 per cent). The importance of this distinction is at present mainly scientific. Patients generally classed as myalgics fall broadly into two distinct classes. In the one class there is no pain when the patient is warm in bed unless he attempts to move. Rest makes him stiff. This stiffness wears off with gentle movement. There is pain, often described as acute and stabbing, on quick movement. Prolonged exertion precipitates or increases the condition. This is true myalgia. In the other class there is pain of a character which is variously described as "aching," "gnawing" and "throbbing," which is *aggravated* when the patient is warm in bed and persists although he be absolutely motionless. He complains of inability to sleep. There is often considerable cutaneous hyperæsthesia. This class of case I have called "neuralgia." It is very distinct from myalgia.

The forty-six cases include two cases of severe neuralgia of the feet following exposure, and five cases more or less confined to the upper extremity. But the majority followed the usual myalgic distribution—viz., lumbo-sacral and lower extremity.

The curiosities of *muscular stiffness following considerable exertion* (2 cases = 1 per cent), *gout* (1 case = 0·5 per cent) and *muscular cramps* (1 case = 0·5 per cent) complete the 108 cases in which, in a series of 200, the diagnosis myalgia was susceptible of improvement by the application

of diagnostic criteria suitable, by reason of their simplicity, to forward areas.

II.—SYMPTOMS AND SIGNS OF MYALGIA.

After the exclusion of the conditions dealt with above under the heading "Differential Diagnosis," there remains a residue. A number of cases with rheumatic symptoms reporting sick at the medical inspection room of a battalion were examined with a view to determining what are the leading features of myalgia (using the term in a restricted sense) as seen in forward areas. The hope was entertained that a sufficient definition of the condition might be obtained to render diagnosis more certain and rapid.

The question of *malinger*ing assumed considerable importance in the inquiry. Gross malingering was in my experience uncommon; but the exaggeration of symptoms was very prevalent among those who were in the habit of reporting sick. A lugubrious outlook is common among patients, due as much to their failure to rise above the misery and hardship of their surroundings as to their actual pains. Such patients, whose spirit has been damped, even if not actually extinguished, form the considerable majority I think of the sick of the Army in forward areas; and are clearly unsuited to be the media of a scientific inquiry into which symptoms enter more than physical signs. Nor under war conditions may much tempering of the wind be accorded to these "shorn lambs"—at the expense of their more spirited comrades.

Only patients whose mental health had not suffered too severely from the strain of war are represented in the figures which follow. Thus the inquiry was begun in 264 cases. But in 214 of these it was abandoned either owing to another diagnosis being made, or owing to the vitiated mental outlook or inferior intelligence of the patient, or owing to the slightness of the case. The inquiry was concluded in fifty cases, which may be taken as typical of genuine uncomplicated myalgia as seen in forward areas.

The regions affected were as follows: Cervical 1, dorsal 9, intercostal 2, lumbar 36, sacral 28, shoulder 6, arm 1, elbow 1, forearm 1, wrist 0, hand 0, buttock 15; thigh: anterior 7, lateral 23, posterior 34, mesial 10; knee 31; leg: anterior 16, posterior 12, lateral 21; ankle 4, foot 6. An attempt to define more exactly the muscle groups involved by observing the effects of active and passive movement of various groups had to be abandoned owing to the claims of other work.

The distribution is usually symmetrical (thirty-six cases) and is in the majority of cases lumbo-sacral extending down the lower extremities for a varying distance. The lumbar and sacral pains are by no means always co-existent. In fact, the general rule is for the pain to be either lumbar or sacral, the thigh pains being superadded in each case. Occasionally the pains are present in the lower extremities but absent in the lumbar and sacral regions; and the converse is common in convalescence. One case of "stiff neck" occurred in the series and two cases of pleurodynia. No

case of pure acute lumbago was seen. In one case the pain was confined to the upper extremity.

Pain is absent when the patient is lying down, warm, and perfectly still (44 cases). This is a marked distinction from pyrexial, post-pyrexial, and neuralgic conditions. In these the pain is aggravated when the patient is warm in bed.

Rest makes the patient stiffer (46). This stiffness wears off on moving about gently (34). Active contraction and passive hyperextension, especially if quick, cause pain which is described as sharp rather than dull (45). Cold and damp weather precipitates or aggravates the condition (37). Prolonged exertion (route marching with full pack, digging, &c.) have a like effect (41). Massage is painful (27 cases out of 31), but beneficial (21 cases out of 31). The condition is chronic (previous attacks in 44 cases). The site of the pain is generally identical in successive attacks (29 cases out of 44). The onset is usually sudden (35).

There appears to be no connection between previous pyrexial attacks and myalgia. But in the case of neuralgia (see "Differential Diagnosis" above) there would seem to be a definite relationship. The young are not exempt (one case aged 19), but the condition is uncommon under 30, and increasingly common thereafter.

III.—DEFINITION OF MYALGIA.

The practical delimitation of myalgia by more accurate differential diagnosis is, perhaps, more important than its definition in words. But from the foregoing it may be said that myalgia is a chronic condition, precipitated or exacerbated by cold, damp and fatigue, affecting groups of muscles, and characterized by muscular stiffness becoming greater on resting and less with movement; and by pain, absent at complete rest, and sharp on active contraction and passive hyperextension. It is to be distinguished from neuralgia by the facts that in neuralgia the pain is aggravated when the patient is warm and motionless, and that in neuralgia hyperæsthesia of the skin is commonly present.

IV.—A METHOD FOUND USEFUL IN FORWARD AREAS FOR EXAMINING PATIENTS COMPLAINING OF RHEUMATIC PAINS.

The number of cases of rheumatic pains coming under the notice of the regimental medical officer is large. In my experience he is called upon to give a decision in such cases upwards of 2,000 times in the course of a year in the forward area, the same patient often, of course, reporting sick repeatedly.

Under these circumstances the plan of making a fairly complete examination at the outset and, as an aid to memory, noting the result in an alphabetical book kept for the purpose, or by hieroglyphic in the patient's pay book, has been found to meet the case. It not only saves a vast amount of time in the long run, but provides at once a diagnosis that is as accurate as possible. It prevents the sick parade from becoming a farce, and ensures that justice is done alike to the genuine case and to the "skrimshanker."

The method of examination which follows is necessarily a simple and a rapid one, and takes more notice of symptoms than of physical signs; but it has been found useful in arriving at a fairly accurate diagnosis under conditions which make diagnosis difficult. The method is as follows:—

(1) Take the temperature, evening if possible. If not, pay special attention to headache and other feverish symptoms. While taking the temperature, note (2) general appearance; (3) apparent age; (4) pupils (especially for the contraction of insomnia); (5) conjunctival anæmia; (6) pulse; (7) respiration. Note also (8) the condition of the tongue.

These observations eliminate pyrexial conditions and acute illness generally.

Interrogate the patient as follows: (9) "Where do you get pain?" (10) "Where is it worst?" (11) "When do you notice the pain most?" (12) "Is there any pain when you are lying down, warm, and *perfectly still*?"

The answers to these questions may suggest arthritis (examine for creaking and gross joint signs), sciatica (examine for Kernig's sign and nerve tenderness), tibial ostalgia (examine for tenderness over the subcutaneous surface), or neuralgia (examine for cutaneous hyperæsthesia, and inquire for history of previous pyrexia).

Then proceed: (13) "Is this your first attack?" (14) "How long have you been subject to these attacks?" (15) "What brings them on?" (16) "Do they always affect you in the same place?" (17) "What do you do for them?"

The last question aids in determining the severity of the case.

The attempt should next be made to produce pain by active and passive movement, the patient's appearance being noted the while.

Then ask: (18) "Is the pain sharp or dull?" If he has had any rubbing or massage, ask (19) "Is massage painful?" (20) "Does it do you good?" Proceed to inquire about stiffness by asking: (21) "Does rest make the stiffness greater or less?" (22) "Does the stiffness get greater or less when you are up and moving about?"

Conclude with some such phrase as: (23) "When you move *quickly* you get a sharp stabbing pain. Can you do as much as anybody else if you go slow?"

The last question is a valuable one for testing the patient's mental outlook. It puts him on his mettle. A genuine case answers in the affirmative, or with a negative that is obviously reluctant. Cases in which there is unwillingness of the spirit as well as weakness of the flesh are not ashamed to give a negative, the tone of which is whining in "war-worn" cases, and impressive, indignant or sanctimonious in patients who are knowingly exaggerating their symptoms.

If the answers seem to coincide with the definition of myalgia given above, the diagnosis is made and a note registered for future reference as to the degree of the condition, and as to the degree, if any, of exaggeration employed.

POST-DYSENTERIC DIARRHŒA AND ITS TREATMENT.

AN EXCERPT FROM NOTES ON 2,000 CASES AT THE MILITARY DYSENTERY
CONVALESCENT HOSPITAL AT BARTON-ON-SEA.

BY CAPTAIN WILLIAM WADDELL.

Royal Army Medical Corps.

THIS is the commonest sequela of an attack of acute dysentery, and it follows both the amœbic and bacillary form of the disease with little distinction between. The post-amœbic diarrhœa is certainly more persistent, and is more prone to relapses—the post-bacillary more easily controlled, and does not relapse so often as the former.

Ordinary astringents may abate the diarrhœa in both cases, and in some cases, no doubt, stop it, but in most it returns as soon as the astringent medicine is discontinued, and the case may go on like this for months.

The unsatisfactory results from the use of astringents led me to inspect regularly the dejecta, and much information was obtainable as to why astringents fail so frequently. The motions varied from very pale, and almost jaundice-like colour, to dark-brown green; they were full of undigested food particles, and were all more or less putrid and highly offensive.

The patients passing these motions, which vary in number from two to eight or ten daily, are naturally more or less debilitated and down in weight—poor appetites, sclerotics, yellow, dull, and injected, usually pale of complexion, languid and dull.

All the symptoms, objective and subjective, indicate a derangement of the liver functions—particularly a dyscrasia of the bile, a reduced output, or both.

A chemically deranged bile must needs result in a non-digestion of the bowel contents, and if also the bile flow is diminished, the antiseptic qualities being also inhibited, putrefaction of the bowel contents is directly encouraged.

No worse condition could exist where intestinal catarrh is present than that the contents of the already irritated intestines should be in such irritating and septic conditions, as already has been pointed out.

Astringents, therefore, often fail entirely, or only partially succeed in bottling up the poisonous bowel contents—and, perhaps, it is often fortunate they do fail.

Castor oil will give great relief to these cases, but only temporarily, so also will mag. sulph.; but neither will bring about a large flow of clean healthy bile, the thing so much required. This, however, can be easily done by full doses of tincture of rhubarb, and my routine is to give every such

case not less than from four drachms, or even six drachms, at one dose. Forty-eight hours having been allowed to work it off, the motions are again inspected. If their colour and composition are still unsatisfactory, a second, or even a third similar dose is given. When their colour assumes a healthy brown or yellow tone, it indicates that the whole bowel is now freely flushed with clean healthy bile, and its putrid contents got rid of. In many cases the diarrhœa now stops of its own accord, but if it still continues, a few doses of some binding medicine will be now safe and successful. Usually I give thirty grains bismuth subnitrate with ten drops hydrochloric acid and ten of tinct. opii, two or three doses daily.

The diet should be soft and bland so far as possible, and a tonic containing pepsine should follow cessation of the diarrhœa.

Calomel is too severe, and causes a lot of colic; so does podophyllin. Euonymin is uncertain. Small doses of tinct. rhei are quite useless; the dose must be large, and its action full and speedy.

In Carrier cases tinct. rhei co. is useless.



Clinical and other Notes.

VINCENT'S ANGINA.

By CAPTAIN E. EMRYS-ROBERTS, M.D.

Royal Army Medical Corps,

Mobile Bacteriological Laboratory, B.E.F., France.

In view of the widespread incidence amongst our troops on this front of affections of the throat and gums due to the fusiform bacillus and spirochæte of Vincent's angina, it may be of value to indicate a method of treatment that has met with unvarying success since its adoption in the area served by this laboratory during the last eighteen months. The treatment consists in the local application of the following lotion :—

Hydrogen peroxide	..	..	..	3v
Vinum ipecac.	..	..	..	3iii
Glycerine	..	..	..	3v
Aq. ad	..	..	..	3viii

By its use the familiar gingivitis is usually cured in about six days, while the throat condition clears up altogether in from twenty-four to forty-eight hours.

Vincent's angina of the throat is not only met with as a separate infection, but is very frequently associated with diphtheria. An analysis of the cases that have reached this laboratory shows that in nearly sixty per cent of diphtheritic throats both fusiform bacilli and spirochætes are present in a further fifteen per cent.

The rationale of the formula was based upon the following considerations: Firstly, that hydrogen peroxide is especially useful in loosening and clearing up purulent exudates, and, moreover, would militate against the growth and multiplication of the anaerobic fusiform bacillus; secondly, that vinum ipecacuanha might prove to have a more or less specific action upon the spirochæte; and thirdly, that glycerine by virtue of its hygroscopic and penetrative properties would effectually convey the preceding ingredients into otherwise inaccessible recesses. Whatever may be the theoretical value of these surmises, the practical issue is beyond doubt, and the consistent results obtained would appear to merit the general use of this lotion in Vincent's angina infections.

I wish to thank Captain Mallet, L.D.S., Captain Place, L.D.S., and the many medical officers in casualty clearing stations and field ambulances who have kindly reported their results.

VENEREAL DISEASE IN THE FIELD.

By CAPTAIN F. CROSBIE.

Royal Army Medical Corps.

THE purpose of this article is to outline briefly the methods which have proved most satisfactory in dealing with venereal disease in a hospital in the field, where one is working entirely under canvas and with a necessarily restricted armamentarium.

The results may be roughly gauged from the statistics appended to various portions of the article, these having been compiled from the admissions and

discharges during the year 1916. They do not include sixty-nine officers treated during the year. Each of the recognized varieties will be dealt with in turn: (1) gonorrhœa; (2) venereal sore; and (3) syphilis.

GONORRHOEA.

On admission of a suspected case a film is taken from the urethra and microscoped immediately. It is only in chronic cases that a diagnosis is made from the clinical history alone, as a large proportion of these fail to yield gonococci on direct examination.

Having made a definite diagnosis in an early case one proceeds to treatment, and this again is controlled as far as possible by the microscope.

In the following description the expression "negative film" is used to denote one in which both gonococci and pus are completely absent.

(1) Urethro-vesical irrigations with 1 in 8,000 potassium permanganate solution three times a day. The man is taught to do this in the erect position, and in the great majority of cases no difficulty is experienced. The apparatus consists of a four-gallon petrol tin, suspended from a marquee pole at a height of ten feet from the ground; this is connected with a metal Miocchi nozzle by six feet of rubber tubing. We have twelve of these outfits in constant use, and it takes an average of four minutes for each irrigation.

(2) When the man has successfully accomplished the above for about five days, protargol (two drachms of a five per cent solution) is instilled along his entire urethra by means of an olivary catheter attached to a Guyon's syringe. This is performed immediately after the mid-day irrigation three times a week.

(3) Massage of the glands in relation to the urethra (*viz.*, prostate, Cowper and seminal vesicles) is instituted about the third or fourth week—*i.e.*, when the discharge has become watery and gonococci have disappeared.

(4) As soon as films prepared subsequent to the above procedure prove "negative," and all pain is absent, dilatation with curved metal sounds is resorted to.

(5) If in spite of this films remain "negative" all treatment is discontinued for three days, and a film taken before micturition on the fourth morning.

(6) If this is "negative" silver nitrate (two drachms of a one per cent solution) is instilled, and films examined for gonococci on three successive mornings. If these do not appear, the patient is discharged.

In confirmed cases the strength of the potassium permanganate solution may be gradually increased up to 1 in 2,000, or 1 in 200 zinc sulphate substituted. Where a mixed infection is present, and oxycyanide of mercury is unobtainable, solutions of hydrarg. biniodide may be employed in strengths varying from 1 in 40,000 to 1 in 10,000.

In chronic or relapsing cases treatment from the beginning should combine all stages up to and including "D." If one is not in possession of a dilator of the type of Kollmans, dilatation should be pushed at least up to 20 English.

Cases are grouped as follows:—

(a) Fresh: Those in which the discharge has been constant since infection, and therefore not necessarily at an early stage.

(b) Uncertain: Those which have had a previous attack which has cleared up, and have been exposed to reinfection recently.

(c) Relapse: Those in which all symptoms had been cleared up, and in which discharge recurred without any admitted exposure to infection.

	Total Per cent		Fresh cases Per cent		Uncertain cases Per cent		Relapses Per cent
Number of cases treated ..	802	..	473	..	102	..	199
Average number of weeks in hospital	9.23	..	9.04	..	8.22	..	9.04
Percentage of cases relapsing after discharge from hospital ..	3.49	..	2.32	..	1.96	..	7.53
Percentage of cases admitted with complications	15.83	..	13.31	..	11.76	..	25.62
Percentage of cases developing complications	3.49	..	3.38	..	2.94	..	3.01
Percentage of cases evacuated to hospital ship	1.87	..	0.84	..	0.90	..	5.02
<i>Complications.</i>							
Percentage of cases admitted with epididymitis	9.22	..	9.09	..	8.82	..	11.05
Percentage of cases developing epididymitis after first admission..	2.99	..	3.81	..	1.96	..	2.01
Percentage of cases admitted with arthritis	1.99	..	0.84	..	0.90	..	5.52
Percentage of cases developing arthritis after first admission..	0.49	..	0.21	..	0.90	..	1.00
Percentage of cases admitted with condylomata acuminata.. ..	3.24	..	3.59	..	2.94	..	5.02
Percentage of cases developing condylomata acuminata after first admission	—	..	—	..	—	..	—
Percentage of cases admitted with stricture	0.99	..	0.63	..	—	..	2.51
Percentage of cases developing stricture after first admission ..	—	..	—	..	—	..	—

VENEREAL SORE.

Venereal sores may be classified according to their bacteriological origin as follows:—

- (A) Those due to the spirochæte of syphilis.
- (B) Those due to the strepto-bacillus of Ducrey.
- (C) Those due to ordinary "septic" micro-organisms.

The clinical picture presented by an uncomplicated case from any one of these three groups is fairly constant. Unfortunately, for purposes of diagnosis, one frequently finds a combination of two, or even of all three, varieties in the same lesion. For this reason alone one should never state that any particular sore is definitely non-syphilitic. Neglect of this rule may lead to results beneficial neither to the welfare of the patient nor the reputation of the surgeon.

As soon as a man with a sore is admitted, simple hot water fomentations are ordered. The following day, films of the exudate are stained with weak Giemsa's solution and examined for the spirochæte of syphilis. Should the latter not be present, and a few weeks have elapsed since the man was exposed to infection, a sample of blood-serum is sent to the laboratory and submitted to the Wassermann reaction. In the event of a negative result being returned this may be repeated if considered necessary, but every effort is made to avoid retaining a man in hospital merely for diagnostic purposes.

The treatment of Group A cases is obvious.

Group B cases yield most readily to the iodine derivatives, while those in Group C usually require preliminary fomenting, followed by the application of some weak mercuric preparation.

X-rays have proved useful in intractable cases, excepting those which subsequently proved to be syphilitic.

SYPHILIS.

The routine treatment administered here covers a period of five weeks, and comprises:—

A. Intravenous injection of "kharsivan." Five doses of 0.3 gramme are given at weekly intervals. In order to avoid serious reactions I would insist on five cardinal points:—

(1) Patient to be prepared as for a general anæsthetic, and complete rest ordered for at least twelve hours after injection.

(2) Freshly distilled water to be employed in the preparation of all solutions used.

(3) Each 0.3 gramme "kharsivan" (after neutralization) to be diluted with normal saline to at least 150 cubic centimetres before injection, and injected within fifteen minutes of preparation.

(4) Perfect clarity of the injected solution.

(5) Fluid injected not to enter blood-stream at a lower temperature than the latter.

Total number of intravenous injections of "kharsivan"—2,021. Of these 75 per cent were followed by temperatures of over 100° F.; 7 per cent were followed by vomiting; 31 per cent were followed by rigors; 70 per cent were followed by headache; two cases developed marked urticarial rashes.

B. Daily inunctions with mercuric ointment. The ointment used is composed of ung. hydrarg. fort. one part, vaseline three parts, and one drachm of this is inuncted daily. Close supervision is exercised to insure that this is correctly performed, as I regard it as the most essential part of the treatment, and that to which the patients evince the greatest dislike.

C. Intramuscular injection of mercurial cream. Ten minims (equivalent to one grain) are injected at weekly intervals over a period of five weeks.

As far as possible the patients suffering from venereal sores or syphilis are encouraged to attend to dental and oral hygiene. The rapidity with which salivation, etc., follows on the ingestion of mercury depends primarily on the condition of the mouth and teeth, the actual amount administered playing but a secondary part in its production.

Total number of patients treated for syphilis, 468. Twenty-three (4.91 per cent) were readmitted, having relapsed after treatment. Only eleven of these twenty-three cases had the full course of treatment; the remainder were admitted prior to the middle of February, that being the date when we were first supplied with "kharsivan."

In conclusion, I beg to acknowledge my indebtedness to Lieutenant-Colonel F. Ashe for his kindness in permitting me to publish the details of the above cases.

GUNSHOT WOUND, PERICARDIUM: PYO-PERICARDIUM WITH GAS INFECTION.

BY MAJOR W. J. P. ADYE-CURRAN.
Royal Army Medical Corps.

PTE. W., aged 22, was admitted to No. — General Hospital on October 9, 1916, with small round healed wound over ninth rib left side post-axillary line. There was no wound of exit.

Previous History.—Wounded September 27, 1916, with, he stated, a rifle bullet. He was detained at a Casualty Clearing Station for ten days and sent here. He coughed up blood after being wounded.

Condition on Admission.—The case was looked upon as being a simple penetrating wound of the chest, and except for some crepitations at the left base, nothing further was noted. October 14, 1916: A very loud exocardial sound was heard over the pericardial area of a sharp tapping nature. This was synchronous with the heart-beat and regular, and obliterated the heart sounds except over pulmonary region. The pulse was noticed also to be quick and irregular. The area of cardiac dullness appeared normal and was marked out with pencil on the chest wall. The patient's facial aspect was anxious. There was a cachectic tinge of the skin. October 15, 1916: The area of cardiac dullness had completely disappeared as also the abnormal sound. The heart sounds were inaudible. Sir J. Rose Bradford, K.C.M.G., C.B., kindly saw the case and expressed the opinion that the loss of cardiac dullness indicated a gas infection of the pericardium and advised an exploratory puncture. An X-ray photo showed in the antero-posterior plane a piece of metal, which had the appearance of a piece of shell the size of a hazel-nut towards the base of the heart. This could not be identified in the lateral view. The pericardium was also shown much distended and extending well into the right chest.

Operation the same evening after injecting two per cent novocain and adrenalin; a spinal trochar and cannula was introduced through the fifth intercostal space an inch from the sternum into the pericardium. On withdrawing the cannula there was an escape of gas which could be distinctly heard, and which had a very foul smell. It was then decided to drain the pericardium. The patient's condition did not justify a general anæsthetic. Under local anæsthetic, novocain and adrenalin, after blocking the intercostals, a flap was turned upwards off the chest and the sixth costal cartilage excised. The pericardium, which was greatly thickened, was opened and about eight to ten ounces of foul smelling yellow pus evacuated. A search was then made with a finger for the foreign body, but it could not be found. A quantity of defibrinated blood-clot was found lying in the upper right part of pericardium. A drainage tube was sewn to skin, the end lying just inside the opening of the pericardium. The patient felt nothing of the operation up to the opening of the pericardium, which caused an uncomfortable but not acute pain in the chest. An opening only about two inches long was made for this reason. Profuse discharge of pus continued from the pericardium, which was irrigated with eusol at blood heat twice daily. Pulse very variable. Much improved after irrigation. October 28, 1916: The pericardial opening had contracted, preventing free drainage. Under a general

anæsthetic, open ether, the pericardial wound was enlarged to about three inches. The surface of heart had lost its shiny appearance and was adherent to pericardium near the apex. Another search was made for the foreign body without result. For four weeks a profuse suppuration continued. At first it contained a Gram-positive bacillus and cocci, and later streptococci. The pericardium was still irrigated twice daily, the fluid being ejected forcibly by the heart-beat. The patient was kept raised and leaning toward the left side, though he could not stand this position for long periods. The urine was found to contain albumin, blood-cells and casts, and there was slight œdema of the legs and ankles. The patient's appetite was extraordinarily good, and he was most hopeful and interested in his own case. October 28: Had a rigor, temperature 103.2° F. Sweated profusely and generally appeared to be suffering pain. Considerable toxæmia, though there was nothing in his condition to account for this except the continued suppuration which was markedly lessening daily. November 4: Another rigor and condition appeared one of septicæmia. November 5: 100 cubic centimetres of eusol given by vein, rigor followed. November 7: Delirious at times and appeared very ill. November 8: Eusol 100 cubic centimetres intravenously, temperature lower. November 9: Signs of fluid left pleura, specimen quite clear and sterile. Very persistent hiccough. Tinct. iodine minimum doses repeatedly. November 10: Hiccough severe. November 11: Severe diarrhœa, condition grave. Starch enema and catechu mixture. November 12: Delirium severe, diarrhœa. November 13: Severe diarrhœa, pulse 140. November 15: Ten ounces pleural fluid aspirated, left pleura, turbid. Fall in temperature. Case handed over to No. 7 Canadian General Hospital.

Officer Commanding No. 7 Canadian General Hospital kindly sent me the following note of the progress of the case:—

November 21, 1916: The fluid had accumulated again in the left chest. Patient's general condition improved. November 29: Chest aspirated, seventeen ounces of turbid fluid withdrawn. December 3: Pathologist reported streptococci in pleural fluid. The albumin and casts had disappeared from the urine. Œdema of legs and flanks markedly decreased. Discharge from wound lessened. December 7: Both upper arms swollen and tender (phlebitis). December 23: Swelling of arms lessened. Breath sounds audible over left base. January 1, 1917: General improvement. Slight discharge from wound which was contracted to a sinus-like tract. Some irregularity in cardiac sounds with a wide area of cardiac impulse. Temperature below 99° F.; pulse 104. February 1: Patient sitting up in chair for three hours daily. February 8: Transferred to England. Condition good. Urine secretions normal. Slight œdema of ankles. Some dullness over left base with fine crepitations. Phlebitis of arms recovered. Temperature 99.6° F.; pulse 116; respiration 26.

Note.—Since he has returned to England I have had several letters from him saying he was improving, but that there still was discharge from the wound.

THE SCABIES PROBLEM ON ACTIVE SERVICE.

BY MAJOR H. MACCORMAC, M.D., F.R.C.P.

Royal Army Medical Corps.

AND

CAPTAIN W. D. D. SMALL, M.D., F.R.C.P.E.

Royal Army Medical Corps.

EVERY man incapacitated from duty—it matters not by what means—is a gain to the enemy. From the point of view of the Army and of military efficiency, those diseases ought to rank highest in importance which cause most “casualties.” Judged from this aspect, diseases of the skin occupy one of the premier positions, for under the conditions of trench warfare it is inevitable that they are met with in large numbers. The exact extent of the wastage for which they are responsible is known only to the authorities, but it is apparent to all that—since many are contagious—successful efforts directed towards prevention and cure will amply repay by a very large gain of fighting men.

Of the skin diseases found amongst soldiers—excluding pediculosis—scabies is by far the commonest. When uncomplicated, its effects incapacitate a man but little; but in consequence of the hard conditions of active service secondary pyodermic complications are frequent and severe, and these are a very real cause of prolonged sickness. In contrast to the three or four days required for the complete cure of a simple case, we have found that when pyodermic complications are established the period necessary is greatly prolonged—the average stay in hospital over a large number of cases being 31·67 days. It should be explained that this figure does not include either treatment elsewhere—which sometimes amounted to many weeks—or the days spent in journeying to the base.

Scabies as seen amongst soldiers differs in type from that usually met with in civil practice, and unless the differences are appreciated many cases will not be recognized, leading to dissemination by undetected “carriers.” The eruption is distributed much in the usual fashion, the sites of election being the wrists, hands, penis, lower abdomen, anterior axillary borders, elbows, and buttocks. The characteristic interdigital burrows, however, are but rarely seen: they were present typically in only thirteen¹ of our cases. Vesicles are much more common, though in quite a number of cases the hands are entirely free from lesions of any sort. A correct diagnosis can only be made after inspection of the whole body. In the majority of cases the penis is involved, and the discovery of papules or crusts on either skin or mucous membrane is almost pathognomonic. This serves in doubtful cases to distinguish scabies from the acute pediculosis so frequently seen, and is for this reason an extremely useful diagnostic symptom.

Besides the primary lesions of scabies, others due to secondary coccal infection are common and important. They may be so severe as to mask the primary disease and render it liable to be overlooked. Most common is a variety of impetigo distributed in a characteristic manner on the lower buttocks, elbows,

¹ This figure does not include cases where one or two indefinite lesions could be found after prolonged search: including these, the percentage would be about 45. It is our impression that lately burrows have been observed with more frequency than some months ago.

and knees. The presence of pustules or crusting on one or all of these regions should at once suggest scabies and lead to search for the more primary lesions elsewhere. Occasionally the impetigo becomes very widely spread, but even in such cases a correct diagnosis can be made by observing the characteristic grouping on the regions indicated. In numerous cases the impetigo lesion extends more deeply into the dermis and takes the form of an ecthyma. Occasionally a linear variety of impetigo is present.

Boils and other follicular infections of the skin are frequent, and tend to recur indefinitely so long as the primary scabies remains uncured. No case should be considered as one of simple furunculosis until itch has been carefully sought for and excluded—or, if found, until the patient has had a thorough course of sulphur treatment.

Some degree of adenitis is the rule in all cases of scabies which have developed any form of coccal infection. The glands of the groin are those most frequently involved, and suppuration in this situation forms a not uncommon and often troublesome complication. In the upper limb severe lymphangitis with foci of suppuration seems to constitute the corresponding lesion. These septic foci usually occur in the upper third of the limb, and on its inner aspect.

Dermatitis as a complication of scabies is most frequently the result of unsuitable, misapplied, or too long continued treatment. In these instances, the abdomen, thighs and arms are the commonest sites—and all degrees from simple erythema to moist weeping or exfoliating eczema may be observed.

Subjects of the seborrhœic diathesis seem particularly liable to this complication.

Localized dermatitis may originate in a group of vesicles or other scabetic lesions, which, together with the intervening skin, have become irritated by scratching: considerable local thickening of the skin, becomes superadded and the result is an area of chronic infiltrative dermatitis—in part scabetic and partly artefact. This is most commonly seen in the flexure behind the knee or on the outer aspect of the thigh.

In its diagnosis, scabies must not only be distinguished from the pyodermic conditions apt to be associated with it, but also from pediculosis, pompholyx, syphilis, and an unusual papular urticaria.

From pediculosis, the diagnosis is chiefly made by the difference in distribution, and the absence of infection of hands, wrists and penis. Not only may the two conditions be associated, but the papule,¹ common to both, can only be distinguished with extreme difficulty.

The vesicular lesions of pompholyx are much more deeply seated, more numerous, and more difficult to rupture than those of scabies, and are chiefly limited to the hands and feet.

A single large scabetic lesion on the penis may give rise to question as to whether or not the patient is suffering from venereal disease, and the eruption on the body may be mistaken for a secondary rash; the diagnosis is not always so easy as might be supposed, particularly if risks of venereal infection have recently been incurred. Here also the two conditions may occur together.

¹ Pediculosis as usually seen in France occurs in an acute form and characteristically presents a papular type of eruption.

A type of papular urticaria which we have not observed in civilian practice may simulate scabies very closely. In this condition, small red papules occur over the body generally but particularly on the abdomen and anterior axillary folds; wheals, or some degree of dermatographia, may often be found or induced. Again, the wrists, hands or penis are not involved, and the disease tends to disappear suddenly, while relapse is frequent.

The methods of combating scabies fall under the two headings—prevention and cure.

(a) *Preventative Measures.*—Scabies it is generally accepted is rarely contracted excepting after prolonged and intimate contact with infected material, for the *acarus* does not wander afield like the louse. This being so it is difficult at first sight to explain how the soldier gets the disease. His opportunities for removing clothing and coming into contact with an infected medium are few and are only fully possible when in rest. All the evidence—particularly the occurrence of epidemics amongst officers sleeping in the same dugout, or amongst groups of men quartered together—points to blankets as the chief means of disseminating infection. Prevention then should include frequent disinfection of blankets by such a method as the Clayton sulphur vapour apparatus, or some other accepted form of sterilization. A few cases seem to be contracted from horses, and the protection of the soldier therefore includes efficient treatment of the horse. Great stress is laid by French writers [1] upon the venereal origin of scabies, and this possible source of infection requires to be kept in mind.

Of the greatest importance is the early detection of every case of scabies. Each case undetected acts as a "carrier," and is the potential starting point of an epidemic. Frequent and thorough inspection of the individual soldier is the only means whereby early diagnosis can be assured. Infected men should be segregated and treated as speedily as possible, for—in addition to preventing dissemination—early diagnosis enables treatment to be instituted while the disease is still uncomplicated, and renders its course short—correspondingly conserving manpower.

(b) *Curative measures* should include exposure of the parasite and its ova and their destruction by remedies short of producing dermatitis. The subsequent disinfection of clothing and bedding to prevent reinfection must never be omitted.

Sulphur, it is generally acknowledged, is the most efficient remedy for the treatment of scabies—and certainly by reason of its procurability and cheapness it is that most suited for the extensive requirements of an army. It is a remedy, however, which requires careful and intelligent application, and care must be taken that the patient receives neither too little nor too much treatment—the former leaving him uncured, the latter producing dermatitis, and so increasing his period of unfitness. How this remedy should be employed is already so well known that a repetition of the details would seem unnecessary had it not been for the recent reintroduction of the sulphur vapour method. This form of treatment so scathingly condemned by Hebra [2] in the first half of the last century, seems to have again obtained a certain vogue, in spite of the fact that it was so completely discredited nearly a hundred years ago. Indeed, it has so long been regarded as one of the barbarities of the Dark Ages that it is rarely mentioned in modern text-books. We have had opportunity of observing a

number of cases treated by this method. Some have suffered from severe dermatitis, numerous others have been uncured. The history given by some of these latter is instructive. After the vapour treatment, the itching was relieved, and improvement appeared to take place in the eruption. The patient seemed cured, but after a period of about two weeks the disease again became active, so that it would appear that in these a false sense of security had been obtained and a "carrier" discharged to further disseminate the infection. That a certain number of cases may be cured by this method is probably correct, but its uncertainty and the special danger of dermatitis from which it is inseparable give us no option but to emphatically condemn its use.

Liquid preparations of sulphur, such as Vlemingx's solution (liquor calcis sulphurata) are undoubtedly efficient agents for the cure of scabies, but they also are particularly liable to cause dermatitis, and considerable experience is necessary for their satisfactory employment.

For its simplicity and certainty, no method is so suited for general use as that of simple inunction with sulphur ointment (B.P.), and admirable results will invariably be obtained, if the treatment is conscientiously carried out and with due regard to the necessary details. It must, however, be insisted that the method of application is of paramount importance. This may be briefly outlined as follows:—

(1) On the first day of treatment, the patient is given a hot bath, and provided with plenty of soft soap, and a large moderately stiff nail-brush.

(a) Before entering the bath, he rubs himself thoroughly all over with the soap, massaging it into the skin, and paying particular attention to the fingers, toes, wrists, penis and axillæ. This should be continued for at least ten minutes.

(b) He then enters the bath, which should be both long enough and contain a sufficiency of water to permit of immersion to the neck. After first steeping for fifteen minutes, he scrubs himself vigorously all over with the nail-brush for the purpose of opening burrows and vesicles. In cases where the eruption is particularly severe or painful, this part of the procedure may be correspondingly modified. After the bath, a final inspection should be made, when any unruptured vesicles can be opened with a surgical needle.

The bath is given with the sole object of opening up the haunts of the acarus and exposing it to the action of the parasiticide to follow. It is obvious that shower or steam baths cannot fulfil this purpose, and examination of a patient so treated will reveal the burrows and vesicles still intact.

(2) After removing the soap and drying, a liberal quantity of sulphur ointment (B.P.) is provided, with which the patient rubs himself vigorously all over, from the neck downwards, special attention being paid to the affected parts and to the fingers, wrists, genitals, axillæ, toes and ankles. The ointment must be liberally applied and thoroughly rubbed in, so that when finished he should be literally "soaking" in it.

The inunction is to be repeated in this manner twice daily for three days—i.e., until the patient has had in all six applications. Each must be complete, and for this it is obvious that all clothing be first removed. The treatment of limited parts of the body is useless.

(3) Finally, on the fourth day, but not before, a second bath is given, and all

the patient's clothing and bedding sterilized to prevent reinfection. Even such articles as wrist straps, strings of identity disks, gloves, etc., should be included.

The vast majority of cases, unless there be secondary complications, will be found cured after three such days of treatment. Should any doubt exist, 2 per cent beta-naphthol in vaseline may be used daily for four more days. Only under exceptional circumstances should sulphur ointment be applied for more than three days, since its continued use is liable to cause severe dermatitis. Indeed, in susceptible persons, a mild degree may be occasioned by the three-day treatment. This is usually easily cured by zinc ointment or Lassar's paste. At the completion of treatment, the existence of some degree of itching is not uncommon; this is due to the remedy and does not indicate failure of cure; it will rapidly pass off, and should be disregarded. Some days also will probably elapse before all the lesions of scabies have disappeared, although the man is no longer infective. A certain degree of pigmentation may persist indefinitely.

CONCLUSIONS.

(1) Scabies in soldiers differs in type from the ordinary form of civil practice, particularly in the frequent absence of burrows or other lesions upon the hands, and in the great liability to pyodermic complications.

(2) The primary disease is often masked by complications. In every case of impetigo, boils, dermatitis or inguinal adenitis, scabies must be carefully excluded before the diagnosis is considered complete.

(3) Cases of scabies complicated by any of the above necessitate about ten times as long a period in hospital as do simple cases. Therefore early diagnosis and treatment, before secondary diseases have become established, are of the greatest importance.

(4) Regular medical inspection is essential for the detection of "carriers." Infected men should be segregated and treated at the earliest opportunity. Horses may also require inspection. Blankets, being the chief source of spread, should be sterilized as often as possible.

(5) Treatment by means of sulphur vapour is a method harmful often to the patient, and at all times dangerous to the community in that it manufactures a class of scabies "carrier." In the interests of the Army it should be discontinued.

(6) The method of treatment most suitable to service conditions on account of efficiency, simplicity, and cheapness, is inunction with sulphur ointment, but this must be carried out in a methodical and thorough manner, and with careful attention to the necessary details.

REFERENCES.

[1] MILIAN. *Paris Medical*, May 6, 1916, p. 426.

[2] HEBRA on "Diseases of the Skin" (New Sydenham Society), ii, p. 241.

ON THE TRANSMISSION OF THE SUBTERTIAN MALARIA PARASITE (*PLASMODIUM FALCIPARUM*, WELCH, 1897) BY EGYPTIAN ANOPHELES.

BY CAPTAIN P. H. BAHR.
Royal Army Medical Corps.

HAVING been unable in the past literature of malaria to find any records of the actual development of the subtertian parasite in the local species of *Anopheles* found in Egypt, I have thought it advisable, on account of the prevalence of this form of malaria in certain parts of Egypt, as well as of the prevention of its spread amongst the troops stationed there, to place a short research I carried out in the autumn of 1916 on record.

Five well-recognized species of *Anopheles* have been recorded (Gough, *Bull. Ent. Res.*) as occurring in Egypt; these are:—

- (1) *Anopheles (Cellia) pharoensis* (Theobald).
- (2) *Anopheles squamosus* (Theobald).
- (3) *Anopheles (Myzomyia) turkhudi* (Liston).
- (4) *Anopheles (Pyretophorus) palestinensis* (Theobald).
- (5) *Anopheles (Myzorrhynchus) mauritanus* (Grandpré).

Of these for our present purpose *squamosus* can be left out of count, as it has been recorded but once—by Theobald. The remaining four species, however, appear to be widely distributed in Egypt. On the Canal zone I have found *pharoensis*, *turkhudi* and *mauritanus*. In the Fayoum and Western Oases, *pharoensis*, *turkhudi* and *palestinensis*. In the Cairo district, *pharoensis* and *turkhudi*. With the exception of *turkhudi*, few direct transmission experiments with the subtertian parasite appear to have been performed with any of these species in India or any other country in which they occur.

I will now give a short account of previous evidence with reference to the spread of malaria by these species.

(1) *Anopheles (Cellia) pharoensis*.—The transmission of the benign tertian parasite (*Plasmodium vivax*, Grassi and Feletti, 1890) has been followed out in this species by Newstead, Dutton and Todd, but no work in this direction appears to have been done on the subtertian parasite (*P. falciparum*) in this species.

(2) *Anopheles (Myzomyia) turkhudi*.—This species comprises the following, all of which are synonymous, or are at the most geographical variations:—

Anopheles multicolor, Camboulin, 1902.

Anopheles impunctus, Dönitz, Egypt, 1902.

Pyretophorus chaudoyei, Billet, Algeria, 1903.

Pyretophorus myzofacies, Theobald, India, 1907.

Pyretophorus nigrifasciatus, Theobald, Algeria, 1907.

Myzomyia azriki, Patton, Aden, 1905.

Myzomyia hispaniola, Theobald, North Africa and Spain, 1903.

Zygotes of the subtertian parasite have been found by Stephens, Christophers, and James in the stomach of this insect in India, and it has been regarded as one of the carriers of this parasite in that country (James, *Sci. Mem. Gov. India*, 1902, No. 2, p. 79).

(3) *Anopheles (Pyretophorus) palestinensis*, synonymous with *Pyretophorus sergenti*, Theobald, Algeria.—Under the latter name Ed. and Et. Sergeant have

found sporozoites in this species and regard it as a common carrier in Algeria and Spain. It appears to be distributed in Algeria, Spain, Cyprus and Palestine, as well as in Egypt, where, however, its range is confined to the Western Oases—Kharga, Dakhla, Baharia and Siwa Oases. Though its distribution intimately corresponds with that of subtertian malaria in those localities no direct evidence against it ever appears to have been recorded in Egypt. This species is very closely allied to *turkhudi*, but differs in having the terminal segment of the palp tipped with white in place of black.

I found this species in January, 1917, breeding abundantly in the warm wells in the Dakhla Oasis (the water temperature varying from 80° F. to 120° F.). Adult insects were then abundant in camp, and although the temperature was as low as 1° C. (34° F.) they appeared to be capable of conveying the subtertian parasite to freshly arrived troops, a proportion of whom contracted the disease ten days after arriving in the Oasis. As it is generally stated (Hindle, p. 162) that the development of this parasite ceases below 18° C. (64° F.) the epidemiological evidence I have just recorded requires further elucidation.

(4) *Anopheles (Myzorchynchus) mauritanus* is a rare mosquito in the interior of Egypt and appears to breed according to my experience in brackish water. Owing to its comparative rarity in malarial districts it is doubtful whether it plays any part in the actual transmission of malaria in Egypt, and it is regarded by Ross, as it occurs in Mauritius, in this light.

During the months of October, November and December, 1916, an opportunity presented itself in Cairo of carrying out the transmission of the subtertian parasite in species of *Anopheles* which were, owing to the pools formed by the overflowing of the Nile, most abundant at that time, namely: *Anopheles (Cellia) pharoensis*; *Anopheles (Pyrethrophorus) turkhudi*.

Large numbers of freshly-hatched insects were caught and subsequently fed on a Bulgarian patient from Salonika, whose blood, although he was not suffering from fever, contained large numbers of crescents. These were estimated by means of a Thoma-Zeiss counting apparatus at about 600 per cubic millimetre of blood. The exflagellation of these crescents readily took place from ten to fifteen minutes after blood had been drawn.

Owing to the active co-operation of the patient it was found possible to feed the infected *Anopheles* daily for twenty-two days from the commencement of the experiment on his blood, and a certain number of insects were dissected daily from the second day after feeding onwards. The insects were fed in gauze cages, and were subsequently placed in a damp atmosphere in a chamber kept constantly at a heat of about 25° C.

In order to keep the atmosphere sufficiently damp—and I wish to make clear it is a very essential point for the life of the mosquito—the cages were covered every night with damped Chardin filter paper. Out of the large number successfully fed, thirty-six specimens of *Anopheles (Cellia) pharoensis* survived after the fourth day, and their stomachs were dissected and stained. In one specimen only out of these thirty-six were any developmental forms found. In this two large oöcysts (measuring forty-five microns by thirty microns) containing sporozoites were found on the fifteenth day after the original feed of crescent-containing blood.

It would appear therefore that this species can occasionally act as a trans-

mitter of the subtertian parasite, but probably under natural conditions it is not a significant factor in this respect.

On the other hand only three specimens of *Anopheles (Myzomyia) turkhudi* survived after the third day, and only one to the tenth day after its first feed. On dissection the latter specimen showed an extensive development of pigmented oöcysts in the stomach, no less than ninety-six being counted with a $\frac{1}{4}$ inch lens in a permanent specimen stained with Giemsa. They measured on an average twenty-four microns in diameter.

I have submitted specimens of *Anopheles* of each batch I experimented with to Mr. G. Storey, B.A., F.E.S., of the Entomological Section, Ministry of Agriculture, Egypt, and I am indebted to him for the confirmatory identification of the species.

CONCLUSIONS ON EXPERIMENTAL GROUNDS.

(1) *Anopheles (Myzomyia) turkhudi* is an efficient definitive host of the subtertian malaria parasite in Egypt.

(2) *Anopheles (Cellia) pharoensis* can act as an inefficient and occasional definitive host for the subtertian parasite. This fact is of interest in view of the prevalence of its congener *Anopheles (Cellia) pulcherrima* in Mesopotamia where it is regarded as a probable carrier.

REFERENCES.

- ALCOCK. "Entomology for Medical Officers." 1911.
 CHRISTOPHERS. "Malaria in the Punjab," *Sci. Mem. Gov. Ind.*, 1911, No. 46.
 GOUGH. "Preliminary Notes on Egyptian Mosquitoes," *Bull. Ent. Res.*, vol. xi, Part II, pp. 133-135.
 HINDLE, F. "Flies and Disease—Blood-sucking Flies." Camb. Univ. Press, 1914.
 JAMES. "Malaria in India," *Sci. Mem. Gov. Ind.*, 1902, No. 2.
 NEWSTEAD, DUTTON and TODD. *Ann. Trop. Med. and Par.*, I, No. 1, 1907.
 STEPHENS and CHRISTOPHERS. "The Practical Study of Malaria," 3rd Edition.

THE SUCCESSFUL CONSERVATIVE TREATMENT OF EARLY GAS GANGRENE IN LIMBS BY THE RESECTION OF INFECTED MUSCLES.

BY LIEUTENANT-COLONEL C. H. S. FRANKAU.

Royal Army Medical Corps (T.F.).

CAPTAIN HAMILTON DRUMMOND.

Royal Army Medical Corps (T.F.).

AND

CAPTAIN G. E. NELIGAN.

Royal Army Medical Corps.

AMONG the points brought forward by Colonel Cuthbert Wallace in an article on "Gas Gangrene,"¹ some months ago were the following:—

- (1) It is rare to meet gas gangrene without muscle injury.
- (2) It is chiefly a disease of muscles, and is rarely dangerous unless muscle is involved.

¹ "Gas Gangrene as seen at the Clearing Stations," *British Medical Journal*, September 16, 1916.

(3) The lesion in its early stages may be described as a longitudinal one, running up and down the wounded muscles from the seat of the lesion. Muscles and groups of muscles are involved while others escape.

(4) It is rare to find all the muscles of a segment of a limb involved, save in a segment distal to one in which the main blood supply has been cut off. Thus the whole leg dies and becomes gaseous when the femoral artery has been blocked in the thigh.

(5) There is little tendency for the infection to pass from one muscle to another. This is well shown in amputation stumps where one muscle dies and becomes gaseous, while the rest of the cut muscles remain healthy.

From our own observations in clearing stations over a period ranging up to twenty-one months, it is abundantly clear that these points cannot be controverted. In no case have we seen gas gangrene commencing as a subcutaneous infection; injured muscle is in all cases the initial focus—the appearance of crackling in the subcutaneous tissues being a secondary phenomenon due to extravasation of gas from the infected muscles below.

In view of this it has been our aim to model our treatment on the following lines: to explore the primary focus with a view to attempting to arrest the infection in the muscle or group of muscles involved by *resection* of the infected areas. Such resection may, as will be seen from the cases, involve a part or the whole of single muscles or groups of muscles.

Resection should be limited to cases in which the main vessel of the limb is intact and should be replaced by amputation where the operation must be so extensive as to be likely to give a limb which would be of less value than an artificial limb. Extensive resections however may be performed regardless of the ultimate utility of the limb, as a life-saving operation, it having been quite clear in some of the cases recorded below that an amputation as in Case 13, or a further amputation in Cases 7 and 9 could not have been carried out without very grave risk to life.

Resection should extend until muscle is reached, which has the following characteristics: (1) The colour is unchanged; (2) the contractility is normal; (3) a good blood supply is present, as indicated by free bleeding from the cut surface. Experience has shown that even if such muscles are, as they may be, slightly infected, free drainage and an open wound will arrest further development of the condition.

The treatment of cases after resection is carried out on the following lines: (1) The dressings are reduced to the absolute minimum, i.e., one or two layers of gauze only being placed over the wound so as to allow free access of air and if possible sunshine to the wound region; (2) constant or intermittent irrigation of the wound by some modification of the Carrel method—eusol, saline or peroxide of hydrogen being used as the irrigating fluid.

In connexion with the cases described below, the point must be specially emphasized that gas gangrene had already developed in some of the patients, though they were admitted a very short time after being wounded. In fact in units at the front established gas gangrene has to be treated *ab initio* in addition to gas gangrene developing at a later stage.

We are indebted to Colonel Cuthbert Wallace, consulting surgeon to this Army, for advice and assistance in the treatment of these cases, and to Captain

J. W. McNee and Lieutenant J. S. Dunn, of No. 3 Mobile Laboratory, Royal Army Medical Corps, for the bacteriological and pathological investigations they have made in the cases.

Case 1.—Lieutenant F., wounded 4 p.m., on November 2, 1916, by rifle grenade fragment; admitted at 7.15 p.m., the same day, i.e., three and a quarter hours after being wounded. When admitted he was clearly very ill, although he arrived as a walking case; his pulse was 120, of poor quality and irregular, his tongue was furred and his features pinched and worn. There was an irregular wound the size of a threepenny-piece on the posterior aspect of the right arm, just above the internal condyle of the humerus—there was no exit. The whole upper arm appeared swollen; it was crepitant to the touch and gave a tympanitic note on percussion. The crackling was most marked on the inner aspect of the arm and extended as high as the anterior axillary fold above in front but to not quite so high a level behind. He was given a general anæsthetic at 8 p.m. The wound of entry was first excised, much damage to the triceps was found locally and the projectile could be felt in the inner side of the vessels in the front of the arm at the junction of the lower and middle thirds; a second incision was made over this when the subcutaneous tissues were found to be œdematous and the biceps muscle showed evidence of gas infection. A further incision was accordingly made along the whole length of the biceps muscle from its origin to attachment; this showed the following conditions: some bruising of the inner border of the muscle at the situation of the projectile; discoloration of the inner half of the muscle varying from a dull red colour at either end to a deep plum colour in the centre. Over the discoloured area bubbles of gas were present under the fascia covering the muscle. This half of the muscle did not react to tap stimulation, whereas the outer half was normal in colour and contracted sharply on stimulation. As this appeared to be an infection localized to the inner half of the muscle, the latter portion was resected in its entirety. A tube drain was inserted into the posterior wound; the anterior wounds were left open, small tubes being inserted for continuous eusol irrigation, which was commenced immediately after the operation was completed. The pulse dropped to 88 six hours afterwards, and never rose above this again; the wounds remained clean without pus formation, and on November 9, 1916, were closed by secondary suture, and the eusol irrigation was discontinued. The wounds remained healthy and were practically healed when he was evacuated to the base on November 17, 1916. He had already very fair power in his arm, and the remaining portion of the biceps could be felt contracting.

PATHOLOGICAL REPORT.

An anaerobic gas-forming organism was grown from the excised muscle, which on histological examination showed hyaline degeneration of groups of fibres with separation. This condition represents a very early stage in the process of gangrene. Long bacilli could be recognized between the muscle fibres, but were very scanty.

Note.—The extreme rapidity of the infection in this case is remarkable, occurring as it did within three and a quarter hours of the time of injury, in fact it is the earliest case that we have ever seen. There is no doubt that if any delay had occurred in the treatment the consequences would have been disastrous owing to the virulence of the infection, and the patient would have lost his limb if not

his life. The treatment by resection of half of the muscle rather than the whole, which at first sight would seem to have been the better course, was due to the fact that the infection is known to spread longitudinally along the length of the fibres, and that transverse spread is a late phenomenon occurring in the more advanced stages. The differentiation between living and dead portions of the muscle was made from the presence or absence of contractility, it being well established that heavily infected muscle is non-contractile. (C. H. S. F.)

Case 2.—Lance-Cpl. D., wounded by shell fragment on July 2, 1916, admitted twenty-four hours later, when the following condition was found. Temperature 102·6° F., pulse 118; there was a through-and-through wound in the middle of the left upper arm; the arm was greatly swollen in the neighbourhood and tender on palpation. Subcutaneous crepitation was present. At the operation, which was performed at once, the biceps muscle at the site of the wound was found to be in a state of "black death," and was full of gas; for two inches above and below this the muscle was not contractile, and in the "red death" stage. A long incision was made over the whole length of the biceps and the entire muscular portion was excised. The wound was dressed with gauze soaked in peroxide until all oozing had ceased and then was left exposed to the air and sun under a single layer of gauze. The patient vomited a good deal for two days after the operation, but on the third day this ceased and his temperature and pulse dropped to normal and remained so. No other muscle was affected, and the resection was entirely curative and conserved his limb. He was sent to the base on July 11, 1916, with a healthy granulating wound, and a satisfactory report on his condition was received from England on July 26, 1916. (G. E. N.)

Case 3.—Pte. O., admitted at 7.30 p.m., on October 29, 1916, suffering from multiple shell wounds received the same afternoon. His general condition was good; there was a penetrating wound of the right chest, an in-and-out wound of the right calf and a penetrating wound of the right biceps muscle. The next day he was given a spinal anæsthetic and the wound in the leg was incised and drained. The next day his condition was not so good and he complained of pain in the right arm; pulse 106, temperature 101·8° F. The wound in his arm was the size of a sixpence and was situated over the centre of the biceps muscle. The arm was swollen and the skin was tense and slightly discoloured in the region of the wound. On gentle pressure a small amount of dirty serum with gas bubbles in it escaped from the wound. A general anæsthetic was given and the biceps muscle exposed by a long incision. In the middle third of the muscle deeply situated there was a small cavity containing a fragment of shell; above and below this for a distance of two inches was an area of dead crepitant muscle. The whole necrotic area was excised until healthy muscle was reached which bled on section. The wound was left freely open and dressed with a eusol gauze. He made a straightforward recovery and was evacuated to the base on November 12, 1916. The wound in his arm was then healthy and ready for secondary suture.

(*Note.*—In this case immediate improvement followed resection of the infected muscle. — H. D.)

Case 4.—Pte. G., wounded July 24, 1916, admitted the same day. Shell wounds right buttock, right calf and skull. Immediate operation, trephining, wound of buttock and calf drained and piece of metal removed from soleus

muscle. Twenty-four hours later the calf was very swollen and tender and gas bubbled from the wound on pressure. Temperature 102° F., pulse 112. A second anæsthetic was given and the calf opened up from the lower part of the popliteal space to three inches from the ankle. The gastrocnemius was split down the mid-line and found to be healthy and contractile; the soleus beneath along the track of the projectile was found to be in the black death stage of gangrene, it was crepitant and no part of the muscle was contractile. As much as possible of the muscle was cut away and the wound was flushed out with peroxide and left open to the air, the limb being slung in a cradle for this purpose. The patient was given 100 cubic centimetres of five per cent eusol solution intravenously at the end of the operation. Rapid improvement followed; the temperature and pulse dropped to normal on the next day and he was evacuated to the base on July 30, 1916, with a normal temperature and pulse. The head wound had healed and the other wounds were clean. A note from the Base Hospital stated that he was sent to England on August 5, 1916, having made an uninterrupted recovery.—G. E. N.

Case 5.—Second-Lieutenant G., wounded in the left leg by a rifle bullet at close range at 2.30. a.m., on October 11, 1916, admitted at 9.0. a.m., and operated on immediately. There was a through-and-through wound in the upper and outer part of the left calf—the wound of entry and exit being of about the same size and just large enough to admit the tip of the finger. The wounds were excised and the wound freely drained by means of two large tubes after irrigation with eusol; the wound appeared to be a comparatively trivial one. Eighteen hours later his pulse which had been previously normal ran up to 120, and the patient showed signs of a profound toxæmia; the upper part of the leg was swollen and tender and the skin was glazed; there was no subcutaneous crackling. A further anæsthetic was given and the entire track of the wound, which was about three inches long, was laid open by division of skin and intervening muscles. The peroneus longus and brevis muscles were found to be considerably lacerated, they were altered in colour, crepitant and non-contractile. The dead portions were cut away until healthy bleeding muscle was reached which contracted on stimulation. The wound was left open and treated with continuous eusol drip irrigation. Immediate improvement followed, the pulse dropping to normal within a few hours. He was evacuated to the base nine days later with a healthy granulating wound. Anaerobic gas-forming organisms found in the dead muscle removed.

Note.—This case is of interest as the infection commenced in spite of free and early drainage. Resection of the infected area cut the process completely short.—C. H. S. F.

Case 6.—Cpl. E., was admitted to the station at 5.30 p.m., on August 27, 1916, having been wounded by a shell fragment at 7 p.m. the previous day. On admission he looked flushed, his tongue was dry and his pulse 120, temperature 103° F. There was an entry wound the size of a shilling over the anterior tibial group of muscles at the junction of the middle and lower thirds of the leg; the wound of exit was two inches above the ankle-joint on the posterior aspect of the limb in the middle line. The missile had passed between the two bones of the leg. The limb was very swollen in its lower half and the skin had a white tense glazed appearance; there was considerable pain on palpation. No

subcutaneous crackling was elicited. Under the anæsthetic on raising the limb gas bubbles escaped from the anterior wound with some foul stinking serum. The skin wound was excised and the anterior tibial group of muscles were explored by a six-inch incision. The extensor longus digitorum muscle was exposed—this had been divided across by the missile; the retracted ends showed an opaque sheath with underlying dead non-contractile muscle for an inch on either side of the wound. The dead portions were cut away until normal vascular muscle was reached at either end. About two and a half inches in all were cut away from either end; the anterior tibial artery was exposed at the bottom of the wound but was uninjured. The extensor longus hallucis looked healthy and contracted well. The posterior muscles were not markedly damaged and were not interfered with. The wound was drained and drip irrigation with eusol commenced. The patient made an uninterrupted recovery and was evacuated to the base on September 3, 1916; his pulse was then 90 and his temperature 99° F.; the wounds were granulating.

An anaerobic gas-forming organism was isolated from the removed muscle which on section showed necrosis and irregular fragmentation of muscle fibres; there was cedematous thickening and leucocytic infiltration of the interstitial connective tissue; large bacilli were present in considerable numbers between the dead fibres.

Note.—This case clearly shows the longitudinal spread of the infection in the muscles and how free resection of the diseased muscle arrests any further spread of the infection.—H. D.

Case 7.—Pte. C. was wounded at 4 p.m., on July 29, 1916, by a shell fragment in the region of the left knee. On admission five hours later his condition was very bad owing to loss of blood, pulse 150. Six hours later after warmth and stimulation he was fit for operation and the wound was explored. There were two lacerated wounds on each side of the popliteal space which had evidently been traversed from within outwards; examination showed an extensive fracture of the head of the tibia involving the knee-joint. The pulsations of the main vessel could not be felt; gastrocnemius and soleus muscles were extensively lacerated. The wound was freely drained after irrigation with eusol. The next day his condition was satisfactory until 8 p.m., when his pulse was 120 and his temperature 102·4° F. The region of the wound was more swollen and the skin over the calf had the appearance of a bruise which was fading; percussion gave a tympanitic note over this area; there was no subcutaneous crackling. The knee-joint was also resonant from the presence of gas. The lower third of the leg was cold and there were several light purple patches over the dorsum of the foot. The leg was removed by disarticulation at the knee-joint; examination of the limb showed occlusion of the popliteal artery from a bruise wound and a large hole in the popliteal vein, the gastrocnemius and soleus muscles showed marked gas gangrene. He was much improved the next day, but on the following day his pulse was 120, and his temperature 101·4° F.; the lower third of the thigh was swollen, tender to the touch and resonant to percussion; it was evident that the infection was spreading up the muscles of his thigh. Under chloroform an incision was made up the back of the thigh and the semi-membranosus muscle was found to be gaseous and stinking. It was followed up to the middle of the thigh and resected at this point as the fibres were found to be healthy there.

The anterior aspect of the thigh was then explored and the sartorius muscle was found to be similarly infected in its lower part; the distal four inches were resected through healthy muscle. The wounds were left exposed to the air, being covered by one layer of gauze only; the wound was kept irrigated by a constant eusol drip. The thigh was slung so as to take the weight off the muscles of the back of the limb; suspension was effected by means of a gauze band attached to the exposed condyles of the femur. From this time on he commenced to improve, on the following day his pulse was 96 and temperature 101° F. On August 3, the stump of the popliteal artery, which was lying in a bed of sloughing muscle, commenced to ooze: in order to avoid a secondary hæmorrhage the femoral artery was ligated in Hunter's canal under local anæsthesia. After this he continued to improve and was evacuated to the base on August 15. The muscles were infected with a pure culture of *Bacillus perfringens*.

Note.—It was impossible even to attempt to save the limb in this case by resection of muscle in the first instance owing to the occlusion of the popliteal artery. When the secondary spread of infection occurred into the thigh muscles after the amputation his general condition became rapidly so bad that a further amputation would have been inevitably fatal. Resection of the infected muscle was the only satisfactory course to adopt, as proved to be the case.—H. D.

Case 8.—Pte. P., wounded August 28, 1916, admitted the same day. Through-and-through wound of left thigh with compound fracture of the femur in the upper third. He had had much hemorrhage before admission and was very collapsed on admission—pulse 140, temperature subnormal. Twelve hours later he had improved sufficiently for operation, both wounds were freely opened up, lacerated muscle, fragments of bone and the case of a bullet being removed. The outer wound was kept open with a silver retractor and both were lightly packed with eusol gauze. The limb was immobilized on a Wallace-Maybury splint and the wounds were syringed every two hours with eusol. Patient had a good night but next morning his temperature and pulse began to rise, he complained of pain in the limb and of great thirst. His tongue became dry and brown. On examination the limb was found to be swollen and tense and had a characteristic odour. There was no skin crepitation and no gas-bubbles from the wound. An immediate "chaff cutter" amputation just below the trochanters was performed and the adductor muscles were found to be in the red stage of gas gangrene, so they were completely excised from the stump. The wound was dressed for twenty-four hours in gauze soaked in peroxide and then left exposed to the air under one layer of gauze. Within two days the temperature dropped to normal and the pulse to 90; none of the other muscles in the stump showed any sign of being infected and he was evacuated to the base on September 15, 1916, with a granulating wound. A laboratory report confirmed the diagnosis of gas gangrene. This method of removing a group of infected muscle was also carried out in another case five days after amputation, the adductors here being also removed—no spread occurred in the other muscles.—G. E. N.

Case 9.—Lieutenant B., wounded at 1 a.m. on September 13, 1916, by shell, right leg shattered in lower third. Admitted at 3.30 a.m. the same day. Primary amputation by equal lateral flaps at the middle of the leg was performed at 4 a.m.; at the operation it was noticed that the anterior tibial artery was occluded, there was no change in the muscles which were contractile and

apparently healthy. The wound was freely irrigated with eusol and the flaps which were free were united loosely with three sutures. Free drainage was provided for by means of two tubes which also served for constant eusol irrigation which was started at once. The pulse before the operation was 90, at the end of the operation it was 88. Twenty-six hours later the pulse ran to 120, tongue became furred and dry and the patient was drowsy and obviously very ill. Examination of the wound showed mottling of the skin over the front of the leg, together with a tympanitic note on percussion over the same area; there was no crackling of the subcutaneous tissues. The wound was at once opened up, when it was found that the entire anterior tibial group of muscles were a brick red colour, non-contractile and quite dead. They were removed *en masse* and the wound was left open under constant eusol drip irrigation. The general condition remained bad for twenty-four hours with rapid pulse, drowsiness and persistent vomiting. Steady improvement then followed and the patient was sent to the Base on September 23, 1916, with a healthy granulating wound.

The removed muscles were found to be heavily infected with *B. perfringens* and other gas-forming organisms on culture.

Note.—The only other alternative in this case would have been a further amputation through the thigh, which it is doubtful if the patient would have survived; resection of the muscles avoided this additional danger and gave the patient a much more serviceable stump as the knee-joint was saved.—C. H. S. F.

Case 10.—Pte. P. was wounded by shell fragment on July 23, 1916; admitted July 24, 1916. On admission—temperature 103·6° F., pulse 120. There was a through and through wound of the left thigh, the entry being on the inner side three inches above the patella and the exit two inches higher up on the outer side. The exit wound was swollen, tense and tender, but did not crepitate. Both wounds were excised and united by incising the skin. There was some laceration of the edge of vastus internus; this was cut away, the muscle looked normal and was contractile. The rectus femoris was grooved on its under surface but appeared otherwise normal. The exposed inner edge of vastus externus was brick red and non-contractile and smelt strongly of gas gangrene. An area of four inches by two in the muscle showed signs of red death, the parts beyond were normal and contractile. A free skin incision was made and a piece of muscle eight inches by three enclosing the affected area was excised; the wound was dressed in gauze soaked in peroxide and later exposed to sun and air. The temperature and pulse steadily fell and by July 30, 1916, were 99° F. and 76 respectively. He was sent to the Base on July 30, 1916; the wound then was healthy and granulating and there was no sign of further gas infection. A report from the mobile laboratory stated that the infection was due to an anaerobic gas-forming organism.—G. E. N.

Case 11.—Pte. M., wounded on August 29, 1915, by shell fragment in the left groin: there had been much hæmorrhage at first, necessitating saline infusion in the Field Ambulance, where he was retained until mid-day on August 31, 1915. On admission his condition was grave: tongue brown and dry, pulse 130. There was a ragged wound of entry the size of a shilling, an inch and a half below Poupart's ligament and just to the inner side of the femoral vessels; the skin over the upper third of the thigh and for a hand's breadth above the wound was mottled and discoloured, and showed marked subcutaneous crackling. An

anæsthetic was immediately given and the wound opened up; it was found to extend upwards and outwards towards the anterior superior spine where a fragment of metal and khaki was found in the sartorius muscle. The muscle in this situation was dead and the upper third was cut away. The discoloured and crepitant areas were incised down to deep fascia and freely injected with hydrogen peroxide. No dressing was applied and the wound was kept constantly irrigated with hydrogen peroxide and left exposed to the air and sun. Rapid improvement took place and the man was evacuated to the base with a granulating wound twelve days later. No bacteriological examination was made, but there is no doubt about the condition.

Note.—At the time when this case came under treatment the significance of the muscle resection was not realized, but it seems at least probable that it cut short the process by removing the main focus of infection.—C. H. S. F.

Case 12.—Lance-Cpl. C., wounded in the left thigh by a shell fragment at 3.0 p.m. on March 13, 1916; admitted into hospital at 2.30 p.m. the following day. On admission he looked flushed: temperature 102° F., pulse 130. There was a jagged wound two inches in length on the outer aspect of the lower third of the left thigh. No exit wound. The lower part of the left thigh was swollen and tense and the overlying skin was shiny. There was tenderness on palpation and a tympanitic note was obtained on percussion; there was no subcutaneous crackling. Operation 5.30 p.m. the same day. A long incision down the outer aspect of the thigh exposed the vastus externus muscle, of which the lower half was markedly affected with gas gangrene. A portion of the muscle near the wound of entry was black in colour and the muscle fibres were diffuent. The lower part of the muscle was resected up to the middle of the thigh where healthy contractile muscle was found. As the muscle planes were separated by gas up to the level of the great trochanter the skin incision was carried up to this level. The whole wound was left wide open and dressed with eusol gauze. At 9.0 p.m. the same evening he was given an intravenous injection of eusol 100 cubic centimetres. His pulse dropped the next day and he showed a great improvement; this was maintained and he was evacuated to the Base six days later. Information was received from England a week later that he was progressing well. An anaerobic gas-forming organism was obtained on cultivation from the muscle removed.—H. D.

Case 13.—Pte. B., wounded September 1, 1916, admitted the same day. Shell fragment. Through and through wound of thigh, the entrance being on the inner side two inches below Poupart's ligament and the exit at a corresponding point on the outer side. Under an anæsthetic the skin wounds were excised and the track syringed with eusol and drained. Fifteen hours later the patient complained of great pain in his thigh and of great thirst. Temperature 101° F., pulse 110. On examination the wound was found to be tender, crepitant, and gassy. A further anæsthetic was given and the whole tract of the missile laid open; the sartorius, rectus femoris and inner edge of vastus externus were found to be in the "black death" stage of gas gangrene. An incision was made from the anterior superior iliac spine to the knee and another along the inner side of the thigh; these were stitched back to healthy skin so as to fully expose the wound. All three muscles showed the "black death" stage of gangrene at the site of the wound, toning down through the "red death" stage to normal muscle as the muscles were traced

down the thigh. The muscular part of the rectus femoris was removed and also the sartorius from its origin to just above the knee. A strip of the vastus externus for nearly its entire length and for a width of three inches was also excised. No other muscles appeared to be affected; the wound was dressed with gauze soaked in peroxide and afterwards exposed to the sun and air. For three days he was very ill with a rapid feeble pulse, constant hiccough and persistent vomiting; he however slowly improved, and on September 5, 1916, his pulse was 88 and temperature 100° F.; the hiccough still persisted. Two days later a part of the skin flap sloughed, after which he improved steadily and was evacuated on September 11, 1916, with a healthy granulating wound which was skin grafted at the Base hospital. The diagnosis of gas gangrene was confirmed by the mobile laboratory.—G. E. N.

Case 14.—Cpl. V., wounded in the left thigh by a shell fragment at 5.30 p.m. on September 19, 1916: admitted into the station five hours later. General condition was then good; pulse 100, temperature 99° F. There was an entry wound the size of half-a-crown on the inner and posterior aspect of the thigh at the junction of the middle and upper thirds. The exit wound was at the outer side of the thigh in the middle third—it was very large, admitting the whole hand and the muscles were greatly lacerated. He was operated on immediately after admission; the missile had passed through the vastus externus and biceps muscles close to the femur and had partially divided the sciatic nerve. The wound was freely drained after irrigation with eusol. He continued to do well for two days, when the evening pulse rose from 104 to 132 and the temperature to 102° F. The skin over the exit wound was now a dirty brown colour and the area in the neighbourhood was swollen and tender; there was no subcutaneous crackling. The skin discoloration extended to the popliteal space. A further anæsthetic was given and the large exit wound was freely laid open. In the lower part of the wound the vastus externus muscle was found to be gangrenous; it was non-contractile and gaseous. The infected portion of the muscle was resected until healthy muscle was exposed. In the upper part of the wound the vastus externus was pale and contracted feebly; with clean instruments a piece was removed for examination and the skin was laid freely open over the muscle. Eusol dressings were applied. Immediately improvement followed and he was evacuated to the base on September 26, 1916, with a normal temperature and pulse. Anaerobic gas-forming organisms were cultivated from the dead muscle and were also obtained on culture from the portion of muscle removed from the upper part of the wound.

Note.—This case shows the immediate improvement after resection of the infecting focus, and also that muscle may look healthy and be contractile and yet be infected.—H. D.

Reviews.

MANUAL OF MEDICINE. By Thomas Kirkpatrick Monro, M.A., M.D. Fourth Edition. London: Baillière, Tindall and Cox. 1917. Pp. xxiv and 1045. $8\frac{1}{4} \times 5\frac{1}{2}$.

It is difficult for anyone who is not engaged in teaching the elements of medicine, and whose student days are remote, to form any proper idea of what is and what is not a good book for the particular purpose. We know that there are certain classics—Sir Thomas Watson, Fagge, Osler, and a multitude of other books which do not aspire, either by aim or execution, to take so high a place. Most of these humbler volumes fulfil the object with which they are written.

When a text-book written by a distinguished namesake of a very distinguished predecessor, published in their usual style by a well-known firm, reaches its fourth edition, it seems there is little more that need be said about it.

R. J. S. S.

HINTS FOR R.A.M.C. OFFICERS. By Ramcorps. Edinburgh: William Bryce. 1918. Pp. 56; $4\frac{1}{2} \times 5\frac{1}{2}$. Price 1s. net.

A little book containing much knowledge really useful to the junior R.A.M.C. officer. Careful assimilation of the facts contained therein would save much valuable time, both for the junior officer and his senior. Perhaps a few hints on the relationship between newly joined M.O.s with regimental and other officers, might have been added with advantage. In Chapter II room for a word of warning on the marking of the Sick Report "Duty," with its sometime unpleasing results to the thoughtless, or cocksure M.O., might have been found.

H. S. D.

OXFORD WAR PRIMERS: BURNS AND THEIR TREATMENT. By Dr. J. M. H. Macleod. London: Oxford University Press. 1918. Pp. viii and 160. $6\frac{1}{2} \times 3\frac{3}{4}$. 6s. net.

The profession will gladly welcome Dr. McLeod's book on "Burns and their Treatment." One notes that the old classification of Dupuytren is adhered to, which perhaps is as well. The new methods of treatment by ambrine and scabbing are most carefully described and well worthy of study. The causation of burns is an exhaustive one and includes practically every known agent except perhaps mustard-seed gas. We are pleased to see the picric acid treatment is still recommended, as it has stood the test of many years. The chapter on Electrical Burns is full of interesting facts. The letterpress is a credit to the publisher and the illustrations are excellent.

INJURIES OF THE FACE AND JAW AND THEIR REPAIR, AND THE TREATMENT OF FRACTURED JAWS. By P. Martinier and Dr. G. Lemerle. Translated by H. Lawson Whale, M.D., F.R.C.S. London: Baillière, Tindall and Cox. 1917. Pp. xx + 345. $6\frac{3}{4} \times 4\frac{3}{4}$. Price 5s. net.

This little book, written by P. Martinier and Dr. G. Lemerle, Professors of the Dental School of Paris, and translated by H. Lawson Whale, M.D., F.R.C.S., Captain, R.A.M.C (T.), describes very efficiently the method of construction of those prosthetic appliances necessary for the repair of facial injuries, and is a mine of mechanical detail regarding these appliances. Particularly useful information is to be found in the chapter on laryngeal prosthesis.

Those wishing to study the treatment of facial injuries caused by gunshot wounds should read this valuable little book carefully. Notwithstanding that it

was originally published in France in the early days of the War, it deals principally with the treatment of injuries due to pathological causes, and very little mention is made of the subject of plastic surgery and bone-graft operations, in which such great progress has been made and such experience gained by the opportunities which only a War such as the present could afford.

In those cases of extensive loss of the mandible or maxilla, for example, it is contended that immediate replacement of the loss should be made by prosthetic appliance. This, although favourable in the cases dealt with in this work, has not proved practicable, on account of the degree of sepsis always present, in the treatment of gunshot wounds.

As to the question of the use of paraffin wax for the restoration of contour, we quite agree with the authors on this point, for experience has proved this to be a failure.

With regard to the description contained in this volume of rhinoplasty over a metal apparatus, this method, in the majority of cases, has only met with unsatisfactory results. The more successful method, and one giving far better results, is that of using cartilage supports; and we agree with the translator in his remarks that the authors' comments on total rhinoplasty seem unwarrantably severe.

On the question of fractures of the lower jaw, the author emphasizes in a marked manner the necessity for the preservation of dental adjustment, in opposition to the other school which advocates approximation of fragments in order to obtain, at the expense of articulation if necessary, bony union. Whilst we favour the latter view, it would seem that the authors have been greatly influenced by the nature of cases met with in civilian practice, where loss of substance, except from surgical interference, is very rarely met with—consequently little or no necessity to obtain bony union.

On p. 282, the authors state that a tooth, although tottering, should never be extracted when it is in the immediate region of the fracture. As the translator states, this point has been much debated; and we feel sure that had the writers of this useful little book had extensive experience with gunshot wounds they would be of our opinion that more bone is lost through septic absorption by the retention of teeth than by their extraction in an early stage.

The outstanding value of the work is in the wonderful ingenuity of the mechanical appliances described, and therefore it should be carefully read by, and in the hands of, all interested in this particular branch of surgery.

H. D. G.

INDEX TO VOLUME XXX.

C.N. = Clinical and other Notes.

	PAGE		PAGE
Acne and furunculosis treatment of staphylococcal infections by stannoxyl, by Captain Arthur Compton .. C.N.	515	Arkwright, Major J. A., notes on sixteen cases of blackwater fever occurring in Malta	378
Adye-Curran, Major W. J. P., gunshot wound, pericardium: pyo-pericardium with gas infection C.N.	599	Aylward, Captain B. H. Stanley, X-ray work in a base hospital in France: a few observations of a practical nature	493
Agglutination in the isolation of typhoid and dysentery bacilli from the excreta, by Captain William Fletcher ..	500	Bacillary dysenteries, investigation into results from treatment by serums and salines respectively, by Gertrude Margaret Dobrashian C.N.	441
Agglutination test on series of microbic emulsions, a time-governed slide method, by Captain W. Broughton-Alcock	424	Bacteriological examination of one thousand soldiers convalescent from diseases of the dysentery and enteric groups, report upon, by Captain W. Fletcher..	51
Alkaline hypochlorite solution, stability of, by Lieutenant A. F. McCulloch .. C.N.	522	Bahr, Captain P. H., clinical and pathological co-operation	525
"Ambulance No. 10," by Leslie Buswell, review	114	Bahr, Captain P. H., transmission of the subtertian malaria parasite by Egyptian anopheles C.N.	606
Amputation shield, improvised, by Captain Valentine H. Blake .. C.N.	347	Banks, Captain C., the treatment of 102 carriers of <i>Entamoeba histolytica</i> with emetine bismuth iodide.. .. .	261
Amputations, particularly the treatment of nerves, the technique of, by Edred M. Corner	486	Banks, Lieutenant H. Stanley, thrombosis of cerebral arteries in Paratyphoid B fever occurring in a general hospital in Salonika army .. C.N.	100
Anderson, Captain A. G., clinical types of subtertian malaria, as seen in Salonika in September, October and November, 1916	215	Barton, Captain B. H., a study of 109 cases of trench fever, with special reference to the condition of the heart ..	320
Angina, relationship of Vincent's, to periodontal gingivitis, by Frank E. Taylor and Captain W. H. McKinstry .. C.N.	512	Bilharzia Mission in Egypt, 1915, report on the results of the, by R. T. Leiper..	235
Angina, Vincent's, by Captain E. Emrys-Roberts	595	Blackham, Colonel R. J., foreword, on paper, by the late Captain C. K. McKerrow	175
Anti-dysenteric sero-vaccine, results from use of, by Major H. Graeme Gibson ..	476	Blackwater fever occurring in Malta, notes on sixteen cases of, by Major J. A. Arkwright and Elizabeth H. Lepper ..	378
Antitoxin, observations on a severe case of tetanus treated with intrathecal injections of, by Captain C. C. Worster Drought	94	Blake, Captain Valentine H., improvised amputation shield C.N.	347
Archer, Lieutenant-Colonel G. J. Stoney, a simple and effective method of giving quinine to malarial cases in order to prevent relapses	521	Blood change in gas poisoning, by Captain James Miller	76
Archer, Lieutenant-Colonel G. J. Stoney, cigarette smoking and "nerves," letter	233	Blood-films, a method of staining, by Corporal J. L. Juill C.N.	227

	PAGE		PAGE
"Bones and joints, the after-effects of wounds of," by Aug. Broca, review ..	449	Cooking stove, hay, on active service, by Major H. Reynolds ..	C.N. 342
Boney, Captain T. K., report of a base laboratory in Mesopotamia for 1916, with special reference to water-borne diseases ..	409	Corner, Edred M., the technique of amputations, particularly the treatment of nerves ..	486
Boulenger, Lieutenant C. L., report of a base laboratory in Mesopotamia for 1916, with special reference to water-borne diseases ..	409	CORRESPONDENCE—	
Broca, Aug., "The after-effects of wounds of the bones and joints," review ..	449	Cigarette smoking and "nerves," by Lieutenant-Colonel G. J. Stoney Archer ..	233
Broughton-Alcock, Captain W., a time-governed slide method for the agglutination test on a series of microbic emulsions ..	424	Crean, Major T. J., a study of 109 cases of trench fever, with special reference to the condition of the heart ..	320
Burman, Lieutenant C. E. L., notes on a series of cases of gunshot wounds during the campaign in East Africa ..	296	Crosbie, Captain F., venereal diseases in the field ..	C.N. 595
"Burns and their treatment," by Dr. J. M. H. Macleod, review ..	619	Crossman, Captain L. G., report of a base laboratory in Mesopotamia for 1916, with special reference to water-borne diseases ..	409
Buswell, Leslie, "Ambulance No. 10," review ..	114	Daniels, C. W., "Laboratory studies in tropical medicine," review ..	114
Calhoun, Captain John C., the after-history of war nephritis: war nephritis invalidated to England ..	205	Davidson, Captain A. M., "A graphic record of the work of a gonorrhoea division," review ..	231
Calthrop, Dion Clayton, "The wounded French soldier," review ..	112	Davies, Captain F. C., a preliminary contribution on "P.U.O. (trench fever)" ..	C.N. 92
Carriers of <i>Entamoeba histolytica</i> , treatment with emetine bismuth iodide, by Captains W. Waddell and C. Banks, H. Watson and W. O. Redman King ..	261	Dawson, E. Rumley, "The causation of sex in man," review ..	448
Cerebellar injuries as observed in warfare, symptoms of acute, by Lieutenant-Colonel Gordon Holmes ..	455, 553	Diarrhoea and dysentery, results of examination of stools of 422 cases admitted to No. 3 Australian General Hospital, Cairo, 1916, by Lieutenant-Colonel C. J. Martin, Captain Kellaway and Sister F. E. Williams ..	C.N. 101
Cerebral arteries, thrombosis of, in paratyphoid B fever, occurring in a hospital in Salonika army, by Lieutenant H. Stanley Banks and Captain H. Roker Evans ..	C.N. 100	Diarrhoea and its treatment, post-dysenteric, by Captain W. Waddell ..	593
Cerebrospinal fever epidemic of 1917 at "X" Depot, by Captain J. A. Glover ..	23	Dobrashian, Gertrude Margaret, an investigation into the results from treatment of bacillary dysenteries by serum and by salines respectively ..	C.N. 441
Cerebrospinal fever, tests for identifying specimens of the meningococcus isolated from 354 cases of, by Captain William J. Tulloch ..	115	Donald, Major H. C., "Statistics re gonorrhoea," review ..	354
Chavasse, Captain F. B., "Myalgia," its diagnosis in forward areas ..	587	Drummond, Captain H., successful treatment of early gas gangrene in limbs ..	C.N. 608
Christie, Captain W. L., notes of a case of pneumococcal peritonitis with acute gastric dilatation ..	C.N. 520	Dyke, Captain S. C., clinical observations on one hundred cases of "trench" nephritis ..	190
Collie, Sir John, "Malingering and feigned sickness," review ..	111	Dysentery and diarrhoea, epitome of results of examination of stools of 422 cases admitted to No. 3 Australian General Hospital, Cairo, 1916, by Lieutenant-Colonel C. J. Martin, Captain Kellaway and Sister F. E. Williams ..	C.N. 101
Compton, Captain Arthur, the treatment of staphylococcal infections by stan-noxyl, furunculosis and acne ..	C.N. 515		

	PAGE		PAGE
Dysentery and enteric groups, report upon, bacteriological examination of soldiers convalescent from diseases of, by Captain William Fletcher . . .	51	Fletcher, Captain William, preliminary agglutination in the isolation of typhoid and dysentery bacilli from the excreta	500
Dysentery bacilli from excreta, agglutination in the isolation of typhoid and, by Captain W. Fletcher . . .	500	Fletcher, Captain William, report upon the bacteriological examination of one thousand soldiers convalescent from diseases of the dysentery and enteric groups . . .	51
Dysenteries, bacillary, investigation into results from treatment of, by serum and salines respectively, by Gertrude Margaret Dobrashian . . . C.N.	441	Foulerton, Major A. G. R., on the pathology and treatment of poisoning by trinitrotoluene . . .	535
Dysentery, note on the epidemiology of, by H. M. Woodcock . . . C.N.	110	Fractured jaws, treatment of, by P. Martinier and Dr. C. Lemerle, review	619
Dysentery suspect cases in France, some strains of organisms found in, showing peculiar agglutinating phenomena and sugar reactions, by Captain F. H. B. Smartt . . .	157	Frankau, Lieut.-Col. C. H. S., the successful conservative treatment of early gas gangrene in limbs, by the resection of infected muscles . . . C.N.	608
Eager, Major R., the psychological aspect of an army and an unorganized crowd	88	Freyberger, L., "The practitioner's pocket pharmacology and formulary," review . . .	449
"Electro-therapeutics for military hospitals," by Wilfred Garton, review . .	533	Functional heart disorders, a study of, by J. E. MacIlwaine . . .	357
Emetine bismuth iodide, treatment of 102 carriers of <i>Entamoeba histolytica</i> with, by Captains W. Waddell and C. Banks, H. Watson and W. O. Redman King . . .	261	Furunculosis and acne, treatments of staphylococcal infections by stannoxyl, by Captain Arthur Compton . . C.N.	515
Emrys-Roberts, Captain E., Vincent's angina . . . C.N.	595	Fuso-spirochaetal affections of the mouth and pharynx, by Captain W. H. McKinstry . . .	274
Emulsions, time-governed slide method for agglutination test on series of microbic, by Captain W. Broughton-Alcock . . .	424	Fyffe, Major E. L., notes on a series of cases of gunshot wounds during the campaign in East Africa . . .	296
<i>Entamoeba histolytica</i> , treatment of 102 carriers of, with emetine bismuth iodide, by Captains W. Waddell and C. Banks, H. Watson, and W. O. Redman King . . .	261	Garton, Wilfred, electro-therapeutics for military hospitals . . .	533
Enteric groups, bacteriological examination of soldiers convalescent from diseases of the dysentery and, by Captain William Fletcher . . .	51	Gas gangrene in limbs, successful treatment of early, by Lieut.-Col. C. H. S. Frankau, Captains H. Drummond and G. E. Neligan . . . C.N.	608
Evans, Captain H. Roker, thrombosis of cerebral arteries in paratyphoid B fever occurring in a general hospital in Salonika army . . . C.N.	100	Gas gangrene, the stethoscope as an aid in the early diagnosis of, by Captain B. C. Maybury . . . C.N.	99
Falconer, Major A. W., clinical types of subtertian malaria, as seen in Salonika in September, October, and November, 1916 . . . C.N.	215	Gas poisoning, a blood change in, by Captain James Miller . . .	76
Firth, Colonel R. H., the musings of an idle man . . .	37, 395	Gastric dilatation, notes of a case of pneumococcal peritonitis with acute, by E. F. Syrett, and Captain W. L. Christie . . . C.N.	520
Fleming, Captain A. G., the after-history of war nephritis: war nephritis invalidated to England . . . C.N.	205	George, Captain Ruggles, the after-history of war nephritis, war nephritis invalidated to England . . . C.N.	205
		Gibson, Major H. Graeme, results obtained from the use of anti-dysenteric sero-vaccine in the field, with regard to the reduction of case incidence . .	476

	PAGE		PAGE
Gingivitis, the relationship of Vincent's angina to periodontal, by Frank E. Taylor, and Captain W. H. McKinstry C.N.	512	Jones, A. Bassett, "Malingering or the simulation of disease," review ..	111
Glover, Captain J. A., the cerebrospinal fever epidemic of 1917 at "X" depot	23	Kala-azar, six cases of, their treatment with intravenous injections of tartar emetic: notes on the epidemiology, by Major J. C. Kennedy ..	C.N. 209
Godlee, Sir Rickman, "Lord Lister," review of ..	112	Kellaway, Captain, epitome of the results of the examination of the stools of 422 cases admitted to No. 3 Australian General Hospital, Cairo, for dysentery and diarrhoea, March to August, 1916 C.N.	101
"Gonorrhoea division, a graphic record of the work of a," by Captain A. M. Davidson, review..	231	Kelynack, T. N., "The drink problem of to-day," review ..	230
Gordon, Lieutenant-Colonel M. H., identification of the meningococcus..	1	Kennedy, Major J. C., six cases of kala-azar: (1) their treatment with intravenous injections of tartar emetic; (2) notes on the epidemiology ..	C.N. 209
Graves, Lieutenant B., the carrying of the wounded in trenches ..	C.N. 432	Kenwood, Dr. H. R., "Hygiene and public health," review ..	113
Gunshot wounds during campaign in East Africa, notes on a series of cases of, by Major E. L. Fyffe and Lieutenant C. E. L. Burman ..	296	King, W. O. Redman, the treatment of 102 carriers of <i>Entamoeba histolytica</i> with emetine bismuth iodide ..	261
Gunshot wound, pericardium: pyo-pericardium with gas infection, by Major W. J. P. Adye-Curran ..	C.N. 599	LECTURE—	
"Hand and finger re-education, a system," by Captain C. W. Sewell, review	533	Clinical and pathological co-operation, by Captain P. H. Bahr ..	525
Hay cooking-stove on active service, means of saving fifty to eighty per cent of fuel, by Major L. Reynolds ..	C.N. 342	Leiper, R. T., report on the results of the Bilharzia mission in Egypt, 1915 ..	235
Heart disorders, which occur in soldiers, a clinical study of some functional, by J. E. MacIlwaine..	357	Lepper, Elizabeth H., notes on sixteen cases of blackwater fever occurring in Malta ..	378
"Heath's minor surgery and bandaging," review ..	451	Lice and skin disease, a note on, by Captain F. J. Smith ..	C.N. 519
Hernia of the foramen of Winslow: operation and recovery, by Lieutenant H. E. Rawlence ..	332	"Lister, Lord," by Sir Rickman Godlee, review ..	112
Holmes, Lieutenant-Colonel Gordon, the symptoms of acute cerebellar injuries as observed in warfare ..	455, 553	MacCormac, Major H., the scabies problem on active service ..	C.N. 601
"Hygiene and public health," by Dr. Louis C. Parkes and Dr. H. R. Kenwood, review ..	113	McCulloch, Lieutenant A. F., the stability of an alkaline hypochlorite solution..	C.N. 522
Hypochlorite solution, stability of an alkaline, by Lieutenant A. F. McCulloch..	C.N. 522	Macgregor, Captain R. D., a case of "trench fever" contracted in England C.N.	348
"Hysteria or pithiatism and reflex nervous disorders," by J. Babinski and J. Froment, review..	354	MacIlwaine, J. E., a clinical study of some functional disorders of the heart which occur in soldiers ..	357
les, Captain A. J. H., memorandum on the treatment of painful shins following trench fever, by electro-therapeutical methods ..	C.N. 226	McKerrow, Captain C. K., pyrexias of doubtful origin in an infantry battalion on active service ..	175
Jaundice common at the Dardanelles, 1915, the pathology and etiology of the infectious, by Lieutenant-Colonel C. J. Martin ..	C.N. 102	McKinstry, Captain W. H., fuso-spirochætal affections of the mouth and pharynx ..	274
		McKinstry, Captain W. H., the relationship of Vincent's angina to periodontal gingivitis ..	C.N. 512

	PAGE		PAGE
Malaria in Macedonia, reference to the use of prophylactic quinine, by Captain C. H. Treadgold	571	Meningococcus, identification of the, by Lieutenant-Colonel M. H. Gordon ..	1
Malaria, as seen in Salonika in September, October and November, 1916, clinical types of subtertian, by Major A. W. Falconer, and Captain A. G. Anderson C.N.	215	Meningococcus isolated from 354 cases of cerebrospinal fever, a study of the mechanism of the agglutination and absorption of agglutinin reaction, by Captain William J. Tulloch	115
Malaria cases, simple method of giving quinine to, in order to prevent relapses, by Lieutenant-Colonel G. J. Stoney Archer C.N.	521	Mesopotamia, report of base laboratory for 1916, with reference to water-borne diseases in, by Captains T. K. Boney and L. G. Crossman and Lieutenant C. L. Boulenger	409
Malaria parasite by Egyptian anopheles, transmission of the subtertian, by Captain P. H. Bahr C.N.	606	Microbic emulsions, time-governed slide method for agglutination test of, by Captain W. Broughton-Alcock	424
Malinger in the army, a new test type for the detection of, by Captain Alan W. Sichel	326	Miller, Captain James, a blood change in gas poisoning	76
Malinger and feigned sickness, by Sir John Collie, review	111	Mitchell, Lieutenant-Colonel P., "Memoranda on army general hospitals administration," review	230
Malinger or the simulation of disease, by A. Bassett-Jones, review	111	Morison, Rutherford, remarks on the treatment of infected, especially war, wounds	306
Man, the causation of sex in, by E. Rumby Dawson, review	448	"Myalgia," its diagnosis in forward areas, by Captain F. B. Chavasse ..	587
Man, the musings of an idle, by Colonel R. H. Firth	37, 395	"'Nauheim' treatment of diseases of heart and circulation in England," by Leslie Thorne Thorne, review ..	534
Manson, Sir Patrick, tropical diseases, review of	451	Neligan, Captain G. E., successful treatment of gas gangrene in limbs.. C.N.	608
Martin, Lieutenant-Colonel C. J., concerning the pathology and etiology of the infectious jaundice common at the Dardanelles, 1915 C.N.	102	Nephritis, clinical observations on one hundred cases of "trench," by Captain S. C. Dyke	190
Martin, Lieutenant-Colonel C. J., epitome of the results of examination of the stools of 422 cases admitted to No. 3 Australian General Hospital, Cairo, for dysentery and diarrhoea, March to August, 1916 C.N.	101	Nephritis: war nephritics invalided to England, the after-history of war, by Captains A. Locke Robinson, A. G. Fleming, John C. Calhoun and Ruggles George C.N.	205
Matthews, Lieutenant and Quartermaster R. D., a system of erecting portable stoves, such as are issued to medical units, so as to form an efficient and economical indoor cooker .. C.N.	338	Nerves, the technique of amputations, particularly the treatment of, by Edred M. Corner	486
Maybury, Captain B. C., the stethoscope as an aid in the early diagnosis of gas gangrene C.N.	99	Pack-store, plan for building with minimum material, labour and space, by Major L. Reynolds C.N.	345
"Medicines and some modern remedies," by Bodley Scott, review	229	Paratyphoid B fever, thrombosis of cerebral arteries in, occurring in a hospital in Salonika army, by Lieutenant. H. Stanley Banks and Captain H. Roker Evans C.N.	100
"Medicine, laboratory studies in tropical," by C. W. Daniels, review	114	Parkes, Dr. Louis C., "Hygiene and public health," review	113
"Medicine, manual of," by Thomas K. Morris, review	618	Pathological co-operation, clinical and, lecture, by Captain P. H. Bahr	525

	PAGE	REVIEWS— <i>contd.</i>	PAGE
Peritonitis with acute gastric dilatation, notes of a case of pneumococcal, by E. F. Syrett and Captain W. L. Christie C.N.	520	"Laboratory studies in tropical medicine," by C. W. Daniels ..	114
"Pharmacology and formulary, the practitioner's pocket," by L. Freyberger, review	449	"Lord Lister," by Sir Rickman Godlee ..	112
Pharynx, fuso-spirochaetal affections of the mouth and, by Captain W. H. McKinstrey	274	"Malingering and feigned sickness," by Sir John Collie	111
Pneumococcal peritonitis with acute gastric dilatation, notes of a case of, by E. F. Syrett and Captain W. L. Christie C.N.	520	"Malingering, or the simulation of disease," by A. Bassett Jones ..	111
Pyrexias of doubtful origin in an infantry battalion on active service, by the late Captain C. K. McKerrow	175	"Manual of medicine," by Thomas K. Monro	618
Quinine, simple and effective method of giving to malarial cases in order to prevent relapses, by Lieutenant-Colonel G. J. Stoney Archer .. C.N.	521	"Memoranda on army general hospitals administration by various authors," by Lieutenant-Colonel P. Mitchell..	230
Quinine, prophylactic use of, malaria in Macedonia, by Captain C. H. Treadgold	571	"Military medical manuals: Typhoid fevers and paratyphoid fevers," by H. Vincent and L. Muratel ..	355
Rawlence, Lieutenant H. E., a case of exposure by operation of the intra-pelvic portion of the great sciatic nerve	510	"Modern medicine and some modern remedies," by Thomas Bodley Scott	229
Rawlence, Lieutenant H. E., hernia of the foramen of Winslow, operation and recovery	332	"Review of tropical diseases: a manual of the diseases of warm climates," by Sir Patrick Manson	451
REPORT—		"Statistics <i>re</i> gonorrhœa," by Major H. C. Donald	354
Interim report of the War Office committee for the study of trench fever	351	"Syphilis and the army," by G. Thibierge	532
Retractor, intestinal, by Captain W. S. Richardson C.N.	341	"The after-effects of wounds of the bones and joints," by Aug. Broca ..	449
REVIEWS—		"The causation of sex in man," by E. Rumley Dawson	448
"A graphic record of the work of a gonorrhœa division," by Captain A. M. Davidson	231	"The control of venereal diseases," <i>Edinburgh Review</i> , April, 1916 ..	231
"Ambulance No. 10," by Leslie Buswell	114	"The drink problem of to-day," by T. N. Kelynack	230
"A system of hand and finger re-education," by Captain C. W. Sewell	533	"The 'Nauheim' treatment of diseases of the heart and circulation in England," by Leslie Thorne Thorne ..	534
"Burns and their treatment," by Dr. J. M. H. Macleod	619	"The practitioner's pocket pharmacology and formulary," by L. Freyberger	449
"Electro-therapeutics for military hospitals," by Wilfred Garton	533	"The psychoneuroses of war," by G. Roussy and J. Lhermitte	354
"Emergency surgery," by John W. Sluss	451	"Hysteria or pithiatism and reflex nervous disorders," by J. Babinski and J. Froment	354
"Heath's minor surgery and bandaging," by J. and A. Churchill ..	451	"The wounded French soldier," by Dion Clayton Calthrop	112
"Hints for R.A.M.C. Officers"	619	Reynolds, Major L., a simple and rapid way of making an office table .. C.N.	344
"Hygiene and public health," by Drs. Louis C. Parkes and H. R. Kenwood	113	Reynolds, Major L., plan for building a pack-store with minimum material, labour and space.. .. C.N.	345
"Injuries of the face and jaw and their repair, and treatment of fractured jaws," by P. Martinier and Dr. G. Lemerle.. .. .	619	Reynolds, Major L., the use of the hay cooking stove on active service, a means of saving fifty to eighty per cent of fuel.. .. . C.N.	342
		Richardson, Captain W. S., intestinal retractor C.N.	341

	PAGE		PAGE
Robinson, Captain A. Roche, the after-history of war nephritis, war nephritics invalided to England C.N.	205	Stove, on active service, means of saving fuel, use of the hay cooking, by Major L. Reynolds C.N.	342
Salines, investigations into results from treatment of bacillary dysenteries by serum and, by Gertrude Margaret Dobrashion C.N.	441	Stoves, such as are issued to medical units, a system of erecting portable, by Lieutenant and Quartermaster R. D. Matthews C.N.	338
Scabies on active service, by Major H. MacCormac and Captain W. D. D. Small C.N.	601	Surgery and bandaging, Heath's minor, issued by J. and A. Churchill, review...	451
Sciatic nerve, a case of exposure by operation of great, by Lieutenant H. E. Rawlence	510	Surgery, emergency, by John W. Sluss, review	451
Scott, Thomas Bodley, "Modern medicine and some modern remedies," review ..	229	Syphilis and the Army, by G. Thibierge, review	532
Sero-vaccine in the field, with regard to reduction of case incidence, results obtained from use of anti-dysenteric, by Major H. Graeme Gibson	476	Syrett, E. F., notes of a case of pneumococcal peritonitis with acute gastric dilatation C.N.	520
Serum and salines, investigations into results from treatment of bacillary dysenteries by, by Gertrude Margaret Dobrashion C.N.	441	Table, a simple and rapid way of making an office, by Major L. Reynolds C.N.	344
Sewell, Captain C. W., a system of hand and finger re-education, review ..	533	Taylor, Frank E., the relationship of Vincent's angina to peridental gingivitis C.N.	512
Sex in man, the causation of, review of, by E. Rumley Dawson	448	Taylor, Major Gordon, the story of a tooth plate, an unusual war injury .. C.N.	228
Shield, improvised amputation, by Captain Valentine H. Blake .. C.N.	347	Tetanus, treated with intrathecal injections of antitoxin, recovery, observations on severe case, by Captain C. C. Worster-Drought C.N.	94
Sichel, Captain Alan W., a new test type for the detection of malingerers in the army	326	Thibierge, G., syphilis and the Army ..	532
Skin disease, a note on lice and, by Capt. J. F. Smith C.N.	519	Thorne, Leslie Thorne, the "Nauheim" treatment of diseases of the heart and circulation, in England	534
Slide method for agglutination test on series of microbic emulsions, by Captain W. Broughton-Alcock	424	Thrombosis of cerebral arteries in paratyphoid B fever, occurring in a general hospital in Salonika Army, by Lieutenant H. Stanley Banks and Captain H. Roker Evans .. C.N.	100
Sluss, John W., emergency surgery, review	451	Tooth plate, an unusual war injury, the story of a, by Major Gordon Taylor C.N.	228
Small, Captain W. D. D., scabies problem on active service C.N.	601	Treadgold, Captain C. H., malaria in Macedonia, with reference to use of prophylactic quinine	571
Smartt, Captain F. H. B., some strains of organisms found in dysentery suspect cases in France, showing peculiar agglutinating phenomena and sugar reactions	157	"Trench fever," a preliminary contribution on "P.U.O.," by Captains F. C. Davies and R. P. Weldon .. C.N.	92
Smith, Captain J. F., a note on lice and skin disease C.N.	519	"Trench fever," orandum on the treatment of painful shins following, by electro-therapeutical methods, by Captain A. J. H. Iles C.N.	226
Staphylococcal infections — furunculosis and acne, treatment of, by stannoxyl, by Captain Arthur Compton .. C.N.	515	"Trench fever" contracted in England, a case of, by Captain R. D. Macgregor C.N.	348
Stethoscope as an aid in the early diagnosis of gas gangrene, the, by Captain B. C. Maybury C.N.	99	"Trench fever," interim report of the War Office Committee for the study of, report	351

	PAGE		PAGE
"Trench fever," with special reference to condition of the heart, study of 109 cases of, by Major T. J. Crean and Captain B. H. Barton	320	War nephritis: war nephritis invalided to England, the after-history of, by Captains A. Rocke Robinson, A. G. Fleming, John C. Calhoun, and Ruggles George	C.N. 205
"Trench" nephritis, clinical observations on one hundred cases of, by Captain S. C. Dyke	190	War wounds, remarks on the treatment of the infected, especially, by Rutherford Morison	306
Trinitrotoluene, pathology and treatment by, by Major A. G. R. Foulerton ..	535	Water-borne diseases, report of a base laboratory in Mesopotamia for 1916, with reference to, by Captains T. K. Boney, L. G. Crossman, and Lieutenant C. L. Boulenger	409
"Tropical diseases," by Patrick Manson, review	451	Watson, H., the treatment of 102 carriers of <i>E. histolytica</i> with emetine bismuth iodide	261
Tulloch, Captain William J., a study of the mechanism of the agglutination and absorption of agglutinin reaction, together with an examination of the efficacy of these tests for identifying specimens of the meningococcus isolated from 354 cases of cerebrospinal fever	115	Weldon, Captain R. P., a preliminary contribution on "P.U.O. (trench fever)"	C.N. 92
Typhoid and dysentery bacilli from excreta, agglutination in the isolation of, by Captain William Fletcher ..	500	Williams, Sister F. E., epitome of the results of the examination of the stools of 422 cases admitted to No. 3 Australian General Hospital, Cairo, for dysentery and diarrhoea—March to August 1916	C.N. 101
"Typhoid fevers and paratyphoid fevers," by H. Vincent and L. Muratel, review ..	355	Woodcock, H. M., note on the epidemiology of dysentery	C.N. 110
Vaccine in the field; results obtained from use of anti-dysenteric, with regard to reduction of case incidence, by Major H. Graeme Gibson	476	Worster-Drought, Captain C. C., observations on a severe case of tetanus treated with repeated intrathecal injections of antitoxin, recovery	C.N. 94
Venereal disease in the field, by Captain F. Crosbie	C.N. 595	Wounded in trenches, the carrying of the, by Lieutenant B. Graves	C.N. 432
Venereal diseases, the control of, <i>Edinburgh Review</i> , April, 1916	231	"Wounded French soldier," by Dion Clayton Calthrop, review	112
Vincent, H., "Typhoid fevers and paratyphoid fevers, Military Medical Manuals," review	355	Wounds during campaign in East Africa, notes on a series of cases of gunshot, by Major E. L. Fyffe and Lieutenant C. E. L. Burman	296
Vincent's angina, relationship to periodontal gingivitis, by Frank E. Taylor and Captain W. H. McKinstry ..	C.N. 512	Wounds, remarks on the treatment of infected, especially war, by Rutherford Morison	306
Vincent's angina, by Captain E. Emrys-Roberts	C.N. 595	X-ray work in a base hospital: a few observations of a practical nature, by Captain B. H. Stanley Aylward ..	493
Waddell, Captain W., post-dysenteric diarrhoea and its treatment	593	Yellow fever, recollections of an attack of, by a Patient	146
Waddell, Captain W., the treatment of 102 carriers of <i>E. histolytica</i> with emetine bismuth iodide	261	Yuill, Corporal J. L., a method of staining blood films	C.N. 227

JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.

Corps News.

JANUARY, 1918.

EXTRACTS FROM THE LONDON GAZETTE.

War Office,

December 12, 1917.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Man :—

No. 74787 Pte. (Acting Cpl.) E. J. Richardson, R.A.M.C. (Newton Abbot). (M.M. gazetted January 6, 1917).

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

- | | |
|--|--|
| <p>No. 33202 Pte. (Acting Lance-Corpl.) W. E. Adcock (Parkstone).
 No. 354180 Serjt. J. H. Ashton (Salford).
 No. 387 Pte. (Acting Serjt.) F. Bailey (Walsall).
 No. 473121 Cpl. A. E. Baldwin (Norwich).
 No. 66149 Staff Serjt. W. H. Bishops (Cheltenham).
 No. 41810 Corpl. (Acting Serjt.) F. Booth (Hull).
 No. 37904 Pte. J. Boylan (Dublin).
 No. 497209 Pte. H. Bradford (Kingston-on-Thames).
 No. 32804 Pte. G. Bridgman (Stratford).
 No. 439352 Pte. W. Broom (Bristol).
 No. 30679 Pte. H. Bucksey (Hambleton).
 No. 497171 Pte. S. Burrows (Teddington).
 No. 44223 Pte. H. P. Chapple (Torquay).
 No. 76820 Pte. (Acting Lance-Corpl.) C. Clayton (Leeds).
 No. 497477 Cpl. S. A. Cleal (Fulham).
 No. 75621 Pte. W. Collins (Glazebrook).
 No. 74064 Pte. (Acting Lance-Corpl.) W. J. Cook (Birmingham).
 No. 66855 Cpl. O. Corney (Sandown, I. of W.).
 No. 66974 Pte. H. J. Dolling (Silverton).
 No. 487 Pte. J. Downey (Newcastle).
 No. 64583 Pte. J. R. Dumblyng (Seaham Harbour).
 No. 495231 Pte. R. A. Ellender (Sandwich).
 No. 9065 Pte. J. T. Emery (Gillingham).
 No. 53238 Pte. (Acting Cpl.) T. Estell (Bowes Park, N.).
 No. 46112 Pte. W. J. Evans (Abersychan, Mon.).
 No. 493390 Serjt. L. Farley (Sutton).
 No. 31229 Pte. A. C. Forsyth (Edinburgh).</p> | <p>No. 31649 Serjt. J. B. Gemmill (Glasgow).
 No. 7361 Pte. P. Geraghty (Dublin).
 No. 497261 Serjt. J. Gibson (Penzance).
 No. 3657 Pte. A. Graham, att'd. R.F.A. (Alloa).
 No. 495483 Pte. P. G. Harris (Deal).
 No. 354179 Cpl. J. W. Herbert (Burnley).
 No. 33072 Pte. (Acting Serjt.) J. Howarth (Rochdale).
 No. 36141 Pte. A. Humphrey (Isleworth).
 No. 493720 Pte. A. J. Jervis (Crewe).
 No. 74013 Pte. A. J. Knight (Birmingham).
 No. 24246 Pte. A. Lee (Manchester).
 No. 74032 Pte. S. H. Littlejohn (Southampton).
 No. 53463 Pte. A. W. Lurcock (Margate).
 No. 39115 Serjt. D. McIntosh (Plaistow).
 No. 58957 Pte. (Acting Serjt.) F. W. Medley (Bingley).
 No. 8671 Pte. (Acting Serjt.) T. Mooney (Wavertree).
 No. 64122 Pte. (Acting Lance-Corpl.) T. Muirhead (Glasgow).
 No. 66918 Pte. E. L. Newton (Birmingham).
 No. 495415 Pte. D. Nicholls (Bromley Common).
 No. 45785 Pte. A. Pringle (Thornton).
 No. 66826 Pte. F. Rabjohns (Wellington).
 No. 105623 Pte. H. Radcliffe (Oldham).
 No. 66869 Pte. (Acting Lance-Corpl.) R. Ready (West Bromwich).
 No. 81092 Pte. F. Rowland (New York, Lincoln).
 No. 339164 Pte. J. E. Scott (Liverpool).
 No. 42087 Pte. (Acting Serjt.) J. Seazel (Birmingham).
 No. 497253 Staff Serjt. F. W. Simpson (Banbury).
 No. 64712 Cpl. (Acting Lance-Serjt.) T. Stanger (Stockton-on-Tees).</p> |
|--|--|

No. 508345 Pte. F. W. Tomlin (Walthamstow).
 No. 34986 Pte. (Acting Serjt.) A. Watt (Peterhead).
 No. 493544 Pte. L. M. Webb (Chislehurst).
 No. 33597 Pte. G. H. Webster (Sheffield).
 No. 30254 Pte. J. Welstead (Cork).

No. 12401 Pte. T. F. White (Hastings).
 No. 42629 Pte. H. Whitehead (Bolton).
 No. 54311 Pte. R. E. Williams (Penygroes).
 No. 90816 Pte. C. W. Wilson (Birmingham).
 No. 493580 Lance-Corpl. P. Young (Maidstone).

War Office,
 December 17, 1917.

His Majesty the King has been pleased to confer the undermentioned rewards for Gallantry and Distinguished Service in the Field. The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable:—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. (Temp. Bt.-Col.) Charles Derwent Pye-Smith, D.S.O., M.C., M.B., F.R.C.S., R.A.M.C. (D.S.O., gazetted August 16, 1917).

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. William Howard Lister, M.C., R.A.M.C.

Australian Force.

Capt. William Henry Collins, Australian A.M.C.
 Major Eric Lloyd Hutchinson, A.M.C.
 Major Philip Alan Maplestone, Australian A.M.C.

AWARDED A BAR TO THE MILITARY CROSS.

Capt. Richard Thompson Caesar, M.C., M.D., R.A.M.C. (M.C., gazetted June 18, 1917).
 Temp. Capt. John Maitland Forsyth, M.C., R.A.M.C. (M.C., gazetted September 22, 1916).
 Capt. Cyril Jacobs, M.C., M.B., R.A.M.C. (Special Reserve) (M.C., gazetted July 18, 1917).
 Temp. Capt. David Henry Russell, M.C., M.D., R.A.M.C. (M.C. gazetted August 16, 1917).
 Temp. Capt. Philip Randal Woodhouse, M.C., M.B., R.A.M.C. (M.C., gazetted May 31, 1916).

AWARDED THE MILITARY CROSS.

Temp. Capt. Everard Cecil Abraham, M.B., R.A.M.C.
 Temp. Capt. William Robert Addis, M.B., R.A.M.C.
 Capt. Matthew Thomas Ascough, R.A.M.C.
 Temp. Capt. Arthur Cecil Barker Biggs, R.A.M.C., attached Suffolk Regiment.
 Temp. Capt. George Alexander Birnie, M.B., R.A.M.C.
 Temp. Lieut. Charles Herbert Booth, R.A.M.C.
 Temp. Capt. Robert Briffault, R.A.M.C., attached York and Lancaster Regiment.
 Temp. Capt. George Edwin Chissell, R.A.M.C.
 Temp. Capt. Edward James Clark, M.B., R.A.M.C., attached S. Staffordshire Regiment.
 Temp. Lieut. Arthur Philip Draper, M.D., R.A.M.C.
 Temp. Capt. Frederick Pearson Fisher, M.B., R.A.M.C.
 Capt. Hartas Foxton, R.A.M.C.
 Capt. Reginald Douglas Gwan, M.B., R.A.M.C.
 Capt. Norman Bell Graham, M.B., R.A.M.C.
 Lieut. Arthur Robert Hill, M.B., R.A.M.C. (Special Reserve), attached Gloucestershire Regiment.
 Capt. William Baly Jepson, R.A.M.C. (Special Reserve), attached Devonshire Regiment.
 Capt. Duncan Macfadyen, R.A.M.C. (Special Reserve).
 Capt. Hugh Agnew Macmillan, M.B., R.A.M.C.
 Capt. James McKay, M.B., R.A.M.C. (Special Reserve), attached Bedford Regiment.
 Capt. John Pinder, R.A.M.C.
 Temp. Lieut. (Temp. Capt.) William Leonard Elliot Reynolds, R.A.M.C.
 Capt. William Jack Scade, M.B., R.A.M.C., attached Highland Light Infantry.
 Capt. Charles Nixon Smith, M.B., R.A.M.C.
 Temp. Capt. William Steadman, R.A.M.C.
 Temp. Capt. Frederick Naylor Stewart, M.D., R.A.M.C.
 Temp. Lieut. (Temp. Capt.) Robert Levers Sullivan, M.D., R.A.M.C.
 Temp. Capt. Norman Charles Talbot, M.B., R.A.M.C.
 Capt. Robert Fowler Walker, M.B., R.A.M.C. (Special Reserve).
 Temp. Capt. Henry Currie Watson, M.B., R.A.M.C.
 Temp. Lieut. Robert Everard Whitting, M.D., R.A.M.C.
 Temp. Capt. Frederick Edward Saxby Willis, R.A.M.C., attached Seaforth Highlanders.

Australian Force.

Capt. Walter Leonard Smith, A.M.C.

New Zealand Force.

Lieut. Robert Hector Baxter, N.Z. Medical Corps.
 Capt. Frederick William Lumsden, Medical Corps.
 Capt. John McGhie, N.Z. Medical Corps.
 Capt. Samuel Llewellyn Berpell, N.Z. Medical Corps.

South African Force.

Temp. Capt. Alistair Gordon Forbes, Medical Corps.

The following is the correct description of the Man upon whom a reward has recently been conferred :—

No. 44887 Pte. T. W. H. Newby, R.A.M.C. (D.C.M., gazetted November 19, 1917).

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Man :—

No. 8077 Pte. (Acting Lance-Corpl.) A. Mitchell, R.A.M.C. (Tottenham, N.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

- | | |
|---|---|
| No. 70884 Pte. W. Booth (Denton). | No. 303315 Pte. D. McLeod (Aberdeen). |
| No. 56157 Pte. W. Boyd (attached) (Bradford). | No. 300039 Pte. M. McLeod (Inverness). |
| No. 42655 Pte. J. Brann (Belfast). | No. 316446 Pte. J. McNeil (Glasgow). |
| No. 73957 Pte. (Acting Lance-Cpl.) J. Campbell (Hurlford, Ayr). | No. 92909 Pte. R. C. Mearne (Aberdeen). |
| No. 38545 Pte. E. Carr (Sunderland). | No. 23323 Pte. J. H. Milne (Shanklin, I. of W.). |
| No. 9262 Pte. T. H. Chapman (Ilkeston). | No. 44672 Pte. A. Nicholls (Cowdenbeath). |
| No. 25966 Pte. A. Charlton (Little Hulton). | No. 44721 Pte. A. Nicholls (Essington). |
| No. 66447 Pte. C. S. G. Cheney (Thame). | No. 88374 Pte. A. O'Brien (Glasgow). |
| No. 508344 Serjt. R. Cook (Forest Gate). | No. 8901 Pte. R. Parker (Methill). |
| No. 104476 Pte. H. H. Coulson (Burnley). | No. 56551 Pte. A. Pattinson (Lancaster). |
| No. 31045 Pte. F. J. H. Cox (Hampton Court). | No. 7776 Pte. H. Pye (Burnley). |
| No. 7901 Pte. A. H. Davis (Cheddington). | No. 81587 Pte. J. Robertson (Edinburgh). |
| No. 301288 Lance-Serjt. P. B. Elmslie (Aberdeen). | No. 87977 Pte. R. A. Rodgers (Sheffield). |
| No. 47403 Pte. (Acting Serjt.) A. Flear (Lincoln). | No. 10560 Pte. C. Ryan (Dublin). |
| No. 305181 Serjt. A. Gorrie (Dundee). | No. 103174 Pte. W. Settle (Liscard). |
| No. 66323 Pte. F. G. Harris (Shepherd's Bush). | No. 42875 Pte. A. Smith (Glasgow). |
| No. 1080 Cpl. J. Humphreys (Borough, S.E.). | No. 72383 Pte. J. Smith (Northampton). |
| No. 40773 Pte. S. T. Hunt (Cambridge). | No. 81889 Pte. F. W. Spencer (Newport). |
| No. 66275 Pte. A. Irons (Wadebridge). | No. 34886 Cpl. (Acting Serjt.) T. Thompson (Sheffield). |
| No. 301347 Serjt. D. Jack (Birckoe). | No. 44748 Pte. (Acting Cpl.) J. Thomson (Lochgelly). |
| No. 36734 Pte. J. Jones (Church Stretton). | No. 66430 Pte. E. Ward ((E) Coventry). |
| No. 74399 Pte. A. H. Langdon (Exeter). | No. 66603 Pte. J. N. Warr (Oldswinford). |
| No. 54646 Pte. H. McCabe (Liverpool). | No. 51766 Pte. J. Wood (Manchester). |
| No. 303061 Pte. J. M. McCombie (Inverness). | No. 5225 Cpl. W. T. Young (Edinburgh). |

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, in recognition of valuable services rendered with the Armies in the Field during the present war :—

ROYAL ARMY MEDICAL CORPS.

- | | |
|---|--|
| No. 10220 Serjt. (Acting Serjt.-Major) T. Azeal (Farnborough). | No. 370033 Staff-Serjt. (Acting Serjt.-Major) A. W. Marks (Cardiff). |
| No. 493008 Staff-Serjt. E. T. Baker (Maidstone). | No. 315088 Lnce.-Serjt. J. R. Neville (Muswell Hill, N.). |
| No. 40449 Serjt.-Major A. E. Blaygrove (Oxford). | No. 69049 Serjt. J. F. Noeholson (Stockport). |
| No. 510007 Staff-Serjt. (Acting Serjt.-Major) A. W. Burton (Finsbury Park, N.). | No. 61659 Serjt. R. W. Oldland (Golders Green, N.W.). |
| No. 31858 Staff-Serjt. (Acting Qmr.-Serjt.) W. S. Hawkins (Bletchley). | No. 12058 Serjt.-Major A. W. Pettley (Upper Norwood, S.E.). |
| No. 433012 Serjt. L. Hunt (Erdington). | No. 16049 Qmr.-Serjt. (Temp. Serjt.-Major) P. Springett (Groves, Yorks). |
| No. 527253 Pte. (Acting Serjt.) W. R. Jackson (Warrington). | No. 52113 Staff-Serjt. H. F. Warrington (Itchen). |

MILITARY MEDAL AWARDS.*Amendments.*

The following is the correct description of a Man whose name has appeared in the *London Gazette* for the award of the Military Medal :—

No. 60449 Pte. W. Absalom, R.A.M.C. (gazetted September 28, 1917).

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

*Légion d'Honneur.
Croix de Commandeur.*

Surg.-Gen. Hayward Reader Whitehead, K.C.B., F.R.C.S., Royal Army Medical Corps.

Croix d'Officier.

Lieut.-Col. Francis John Brakenridge, C.M.G., Royal Army Medical Corps.

Lieut.-Col. Herbert John Martin Buist, D.S.O., M.B., Royal Army Medical Corps.

Col. Stephen Frazer Clark, M.B., Royal Army Medical Corps.

Croix de Chevalier.

Capt. William Lombard Murphy, Royal Army Medical Corps.

Croix de Guerre.

Temp. Lieut. William Erling Ord, M.D., Royal Army Medical Corps.

Capt. (Acting Lieut.-Col.) Alexander Donald Fraser, D.S.O., M.C., M.B., Royal Army Medical Corps.

No. 19401 Staff-Serjt. (Acting Serjt.-Major) Albert Edward Harland, Royal Army Medical Corps (Lambeth, S.E.).

CORRECTIONS.

London Gazette, June 2, 1917 :—Page 5451 (and correction page 8664 of August 22, 1917). The decoration awarded to Lieut.-Col. Albert Edouard Le Bel, Canadian Army Medical Corps, should read Croix d'Officier (*Légion d'Honneur*).

War Office,

December 24, 1917.

The following is a continuation of Sir Douglas Haig's Dispatch of November 7, submitting names deserving special mention, published in a Supplement to the *London Gazette* of Friday, December 21, 1917 :—

ARMY MEDICAL SERVICE, HEADQUARTERS STAFF.

Royal Army Medical Corps.

Temp. Capt. W. H. Alderton.

Capt. T. H. Balfour, M.B., M.C.

Lieut.-Col. (Temp. Col.) H. P. W. Barrow, C.M.G.

Capt. W. S. S. Berry.

Col. de B. Birch, C.B., V.D.

Lieut.-Col. (Temp. Col.) R. J. Blackham, C.I.E., D.S.O.

Lieut.-Col. (Temp. Col.) E. W. Bliss, D.S.O.

Lieut.-Col. (Temp. Col.) A. W. N. Bowen, D.S.O.

Col. E. G. Browne, C.B.

Col. (Temp. Surg.-Gen.) C. H. Burtchael, C.B., C.M.G.

Lieut.-Col. (Temp. Col.) F. R. Buswell, C.M.G.

Capt. G. O. Chambers.

Lieut.-Col. A. Chopping, C.M.G.

Capt. A. J. Clarke, M.C. (Special Reserve).

Lieut.-Col. (Acting Col.) R. W. Clements, D.S.O.

Col. G. Cree, C.B., C.M.G.

Lieut.-Col. (Temp. Col.) T. F. Dewar.

Lieut.-Col. (Temp. Col.) H. E. M. Douglas, V.C., D.S.O., C.M.G.

Lieut.-Col. (Temp. Col.) H. N. Dunn, D.S.O.

Capt. G. W. Ellis.

Lieut.-Col. (Temp. Col.) O. W. A. Elsner, D.S.O.

Bt.-Col. H. Ensor, D.S.O.

Col. R. H. Firth.

Lieut.-Col. J. S. Gallic, D.S.O.

Bt.-Col. (Temp. Col.) T. W. Gibbard, K.H.S.

Capt. A. J. Gibson (Special Reserve).

Capt. J. G. Gill.

Col. P. C. H. Gordon.

Lieut.-Col. (Temp. Col.) H. W. Grattan.

Temp. Col. H. McI. W. Gray.

Capt. S. S. Greaves, M.C.

Capt. A. G. Hebblethwaite.

Capt. A. H. Heslop, D.S.O.

Col. S. Hickson, C.B.

Lieut.-Col. H. C. R. Hime.

Temp. Capt. G. D. Hindley.

Lieut.-Col. (Temp. Col.) H. A. Hinge, C.M.G.

Lieut.-Col. (Temp. Col.) J. W. H. Houghton.

Lieut.-Col. (Acting Col.) W. E. Hudleston, D.S.O.

Col. (Temp. Surg.-Gen.) J. M. Irwin, C.B.

Lieut.-Col. (Temp. Col.) T. P. Jones, C.M.G.

Capt. S. D. Large, M.C.

Col. A. J. Luther.

Major W. F. McAllister-Hewlings.

Capt. D. C. Macdonald (Special Reserve).

Col. S. Macdonald, C.M.G., M.B.

Temp. Capt. K. W. Mackenzie.

Col. R. L. B. Macleod, C.B.

Surg.-Gen. W. G. Macpherson, C.B., C.M.G.

Lieut.-Col. H. G. Martin.

Major J. Fitz. G. Martin, C.M.G.

Lieut.-Col. (Temp. Col.) G. A. Moore, C.M.G.

Col. S. G. Moores, C.B.

Col. F. R. Newland, C.M.G.

Surg.-Gen. M. W. O'Keefe, C.B.

Lieut.-Col. (Temp. Col.) G. J. A. Ormsby, M.D., D.S.O.

Capt. G. S. Parkinson.

Lieut.-Col. (Temp. Col.) J. Poe, D.S.O., M.B.

Lieut.-Col. (Temp. Col.) C. E. Pollock, D.S.O.

Surg.-Gen. R. Porter, C.B., M.B.

Lieut.-Col. (Temp. Col.) C. W. Profeit, D.S.O.

Lieut.-Col. (Temp. Col.) H. V. Prynnne.

Lieut.-Col. (Temp. Col.) M. M. Rattray, D.S.O.

Bt. Lieut.-Col. E. Ryan, D.S.O.

Surg.-Gen. R. H. S. Sawyer, C.M.G.

Lieut.-Col. (Temp. Col.) D. D. Shanahan, D.S.O.
 Lieut.-Col. (Temp. Col.) A. D. Sharp, C.M.G.
 Col. J. M. F. Shine.
 Col. (Temp. Surg.-Gen.) B. M. Skinner, C.M.G., M.V.O.
 Lieut.-Col. (Temp. Col.) E. W. Slayter, C.M.G.
 Surg.-Gen. Sir A. T. Sloggett, K.C.B., K.C.M.G. K.H.S.
 Capt. G. W. Smith.
 Col. W. T. Swan, C.B.
 Lieut.-Col. (Temp. Col.) A. G. Thompson, D.S.O., M.B.
 Col. (Temp. Surg.-Gen.) H. N. Thompson, C.M.G., D.S.O.

Major C. G. Thomson, D.S.O.
 Col. H. C. Thurston, C.M.G.
 Lieut.-Col. (Temp. Col.) H. S. Thurston, C.B., C.M.G.
 Major L. V. Thurston, D.S.O.
 Capt. R. E. Todd.
 Lieut. (Temp. Capt.) C. W. Treherne.
 Major A. C. Turner.
 Major (Acting Lieut.-Col.) W. F. Tyndale, C.M.G.
 Major G. W. W. Ware.
 Capt. A. Wilson, M.C., (Special Reserve).
 Col. J. B. Wilson, C.M.G.
 Capt. A. R. Wright.
 Col. R. W. Wright, C.M.G.
 Col. C. A. Young, C.M.G.

Consultants.

Surg.-Gen. Sir A. A. Bowlby, K.C.M.G., K.C.V.O.
 Col. A. Fullerton, C.M.G.
 Col. Sir W. P. Herringham, Kt., C.B.
 Surg.-Gen. Sir G. H. Makins, K.C.M.G.

Lieut.-Col. C. S. Myers.
 Col. W. Pasteur.
 Col. S. M. Smith.
 Col. A. B. Soltan, C.M.G.
 Col. C. G. Watson, C.M.C.

ROYAL ARMY MEDICAL CORPS.

Major W. J. P. Adye-Curran.
 Temp. Capt. E. A. Aldridge.
 Temp. Capt. J. Alexander.
 Temp. Capt. R. C. Alexander.
 Temp. Capt. F. H. Allfrey, M.B.
 Temp. Capt. J. Anderson.
 Temp. Capt. L. Anderson, D.S.O., M.B.
 Temp. Capt. G. W. Armstrong, D.S.O.
 Capt. S. R. Armstrong (Special Reserve).
 Qmr. and Hon. Lieut. C. W. Atkins.
 Temp. Capt. W. H. Attlee.
 Temp. Capt. G. T. Baker.
 Temp. Capt. J. H. Bankes.
 Capt. R. P. Ballard (Special Reserve).
 Temp. Capt. J. H. Barry, D.S.O., M.C.
 Capt. J. H. Bayley, M.C. (Special Reserve).
 Capt. (Temp. Lieut.-Col.) W. J. E. Bell, D.S.O.
 Major (Temp. Lieut.-Col.) W. Bennett, D.S.O.
 Major G. A. Benson.
 Capt. A. J. Beveridge (Special Reserve).
 Qmr. and Hon. Lieut. (Temp. Major) E. Birch.
 Major (Temp. Lieut.-Col.) E. B. Bird, D.S.O.
 Capt. T. R. H. Blake, M.C.
 Major H. D'A. Blumberg, T.D.
 Lieut. (Temp. Capt.) J. H. Boag.
 Temp. Qmr. and Hon. Lieut. E. C. Bowen.
 Capt. (Temp. Lieut.-Col.) J. D. Bowie, D.S.O.
 Temp. Capt. N. McC. Boyce.
 Temp. Capt. E. Boyers.
 Capt. (Acting Lieut.-Col.) F. L. Bradish.
 Capt. (Temp. Lieut.-Col.) F. H. Bradley.
 Capt. E. D. Caddell, M.C.
 Capt. W. K. Campbell, D.S.O.
 Temp. Capt. R. Charles.
 Capt. P. J. Chissell.
 Temp. Capt. G. S. Clancy.
 Temp. Capt. A. Climie.
 Temp. Capt. J. M. Campbell.
 Major T. S. Coates.
 Temp. Qmr. and Hon. Lieut. M. W. Colahan.
 Temp. Lieut. D. H. Collingham.
 Major (Temp. Lieut.-Col.) R. T. Collins.
 Temp. Capt. C. D. Coyle.
 Temp. Capt. F. W. Craig.

Temp. Capt. G. Mol. Dale.
 Temp. Lieut.-Col. J. E. H. Davies.
 Capt. R. M. Davies.
 Capt. A. H. T. Davis.
 Temp. Capt. A. W. Dennis.
 Major (Acting Lieut.-Col.) B. R. Dennis.
 Capt. J. W. Dew.
 Capt. C. K. G. Dick.
 Capt. (Acting Lieut.-Col.) G. H. Dive, D.S.O.
 Temp. Qmr. and Hon. Lieut. G. F. Drayson.
 Temp. Capt. C. F. Drew.
 Major (Temp. Lieut.-Col.) N. E. Dunkerton.
 Temp. Capt. J. C. Dunn, D.S.O., M.C.
 Capt. (Acting Lieut.-Col.) W. Egan.
 Lieut.-Col. T. R. Elliott.
 Qmr. and Hon. Lieut. J. Enwright.
 Capt. (Acting Lieut.-Col.) T. S. Eves.
 Temp. Capt. (Temp. Lieut.-Col.) H. Faulkner.
 Major (Temp. Lieut.-Col.) R. F. M. Fawcett, D.S.O.
 Temp. Capt. I. Feldman.
 Capt. J. McK. Ferguson.
 Temp. Capt. J. H. Fletcher, D.S.O., M.C.
 Qmr. and Hon. Lieut. J. Forman.
 Temp. Qmr. and Hon. Lieut. G. Foster.
 Temp. Capt. A. Fraser.
 Capt. (Temp. Lieut.-Col.) W. R. Gardner (Special Reserve).
 Capt. C. E. H. Gater (Special Reserve).
 Capt. (Acting Lieut.-Col.) H. Gibson.
 Capt. R. E. Gibson.
 Capt. H. Goodman.
 Temp. Capt. W. B. Gordon.
 Qmr. and Hon. Lieut. W. Gough.
 Capt. A. H. Greg.
 Temp. Capt. E. H. Griffin, D.S.O., M.C.
 Temp. Qmr. and Hon. Lieut. T. H. Griggs.
 Capt. (Acting Lieut.-Col.) A. H. Habgood (Special Reserve).
 Temp. Capt. E. L. M. Hackett.
 Temp. Capt. A. E. Hallinan.
 Major (Temp. Lieut.-Col.) P. J. Hanafin, D.S.O.
 Temp. Capt. A. G. P. Hardwick.

Major (Temp. Lieut.-Col.) W. J. S. Harvey, D.S.O.
 Capt. A. J. Hawes.
 Capt. W. S. Haydock (Special Reserve).
 Capt. J. H. Hebb.
 Temp. Capt. R. Herdman.
 Temp. Hon. Capt. E. H. Hicks.
 Temp. Capt. R. McC. Hill, D.S.O.
 Temp. Hon. Major C. W. M. Hope.
 Major (Temp. Lieut.-Col.) G. J. Houghton.
 Temp. Hon. Major T. Houston.
 Lieut.-Col. H. A. L. Howell.
 Major (Temp. Lieut.-Col.) G. W. G. Hughes, D.S.O.
 Major (Temp. Lieut.-Col.) R. N. Hunt.
 Capt. W. M. C. Hunt (Special Reserve).
 Capt. A. H. Huycke.
 Major (Temp. Lieut.-Col.) A. E. S. Irvine.
 Capt. (Acting Lieut.-Col.) A. Irvine-Fortescue.
 Major A. W. A. Irwin.
 Temp. Lieut. W. J. Isbister.
 Lieut.-Col. J. C. Jameson.
 Temp. Lieut. H. S. Johnston.
 Major (Temp. Lieut.-Col.) H. B. Kelly, D.S.O.
 Major (Temp. Lieut.-Col.) G. A. Kempthorne.
 Capt. C. M. Kennedy.
 Capt. M. Kennon.
 Capt. (Temp. Lieut.-Col.) E. J. Kavanagh, M.C.
 Capt. G. D. Laing.
 Capt. (Temp. Lieut.-Col.) J. de P. Langrishe.
 Lieut. (Temp. Capt.) J. la F. Lauder, D.S.O., M.C.
 Temp. Capt. R. D. Laurie.
 Temp. Capt. D. Lees, M.B., D.S.O.
 Major (Acting Lieut.-Col.) E. F. Q. L'Estrange.
 Temp. Capt. O. C. Link.
 Temp. Capt. J. W. Linnell.
 Temp. Capt. T. L. Llewellyn.
 Capt. P. MacCullum, M.C., M.B. (Spec. Res.).
 Temp. Capt. H. L. McCormick.
 Temp. Capt. A. L. McCreery.
 Capt. W. McK. H. McCullagh, M.C. (Spec. Res.).
 Temp. Capt. F. C. Macdonald.
 Capt. J. P. McGreehin.
 Temp. Capt. A. Macintyre.
 Temp. Capt. D. MacIntyre.
 Temp. Capt. E. C. Mackay, M.D.
 Temp. Capt. W. Mackenzie.
 Temp. Capt. G. A. McLarty.
 Temp. Capt. G. D. McLean.
 Temp. Capt. I. C. Maclean, D.S.O., M.C.
 Capt. J. W. McNee (Spec. Res.).
 Temp. Capt. W. R. P. McNeight.
 Temp. Hon. Capt. C. McNeil.
 Capt. D. G. McKae.
 Temp. Capt. J. C. Mackwood.
 Temp. Capt. J. M. B. Manuel.
 Capt. H. F. Marris.
 Temp. Qmr. and Hon. Lieut. R. L. Masters.
 Major (Temp. Lieut.-Col.) S. M. W. Meadows.
 Temp. Qmr. and Hon. Lieut. H. G. Miller.
 Capt. A. D. Moffat.
 Temp. Capt. H. W. Moir.
 Capt. F. R. H. Mollan (Spec. Res.).
 Major E. H. M. Moore.
 Capt. H. S. Moore (Spec. Res.).
 Major (Acting Lieut.-Col.) T. B. Moriarty.
 Lieut.-Col. A. H. Morris.
 Temp. Capt. H. Mortimer.
 Temp. Lieut. D. A. H. Moses.
 Temp. Capt. J. M. Moyes.
 Temp. Qmr. and Hon. Lieut. T. Newling.
 Capt. C. Nicholson, M.B. (Spec. Res.).
 Temp. Capt. H. G. Oliver, M.C.
 Temp. Capt. J. B. Orr, D.S.O., M.C., M.B.
 Major (Temp. Lieut.-Col.) A. C. Osburn, D.S.O.
 Temp. Capt. J. I. O'Sullivan.
 Temp. Capt. H. A. Pallant, D.S.O., M.C.
 Brevet Major H. F. Pantoon, D.S.O., M.C.
 Temp. Qmr. and Hon. Lieut. W. Parnell.
 Capt. G. E. Pepper (Spec. Res.).
 Capt. (Acting Lieut.-Col.) E. C. Phelan, M.C., M.B.
 Capt. G. S. Pirie (killed).
 Capt. (Temp. Lieut.-Col.) A. M. Pollard.
 Capt. R. B. Price, M.B.
 Temp. Capt. (Acting Lieut.-Col.) C. D. Pye-Smith, D.S.O., M.C.
 Capt. W. Raffle.
 Capt. J. Rafter (Spec. Res.).
 Capt. (Acting Lieut.-Col.) H. C. D. Rankin.
 Temp. Hon. Lieut.-Col. N. Raw.
 Capt. J. F. G. Richards.
 Temp. Capt. H. Y. Riddell.
 Temp. Capt. R. C. Robertson.
 Capt. (Acting Lieut.-Col.) R. T. C. Robertson (Special Reserve).
 Temp. Capt. R. S. Ross.
 Temp. Capt. G. W. R. Rudkin.
 Capt. P. J. Ryan, M.B.
 Capt. J. C. Sale, D.S.O., M.C.
 Temp. Capt. M. P. Scanlon.
 Capt. (Acting Lieut.-Col.) J. W. L. Scott.
 Capt. J. J. M. Shaw (Spec. Res.).
 Major (Acting Lieut.-Col.) H. F. Shea.
 Temp. Capt. H. L. Shelton.
 Temp. Capt. S. J. Simpson.
 Major M. Sinclair.
 Temp. Capt. V. F. Soothill.
 Major (Temp. Lieut.-Col.) W. M. B. Sparkes, D.S.O.
 Capt. J. C. Sproule.
 Temp. Capt. T. Stansfield.
 Capt. J. Stephenson (Special Reserve).
 Temp. Capt. J. L. Stewart, M.C.
 Capt. A. D. Stirling.
 Temp. Capt. A. Stokes, M.D., F.R.C.S.I.
 Temp. Capt. D. J. Stokes.
 Temp. Capt. H. S. Sugars, D.S.O., M.C.
 Temp. Capt. R. I. Sullivan.
 Capt. F. Sykes (Special Reserve).
 Temp. Capt. J. Tate.
 Capt. (Temp. Lieut.-Col.) G. P. Taylor, M.C.
 Capt. (Temp. Lieut.-Col.) W. I. Thompson.
 Temp. Capt. J. N. L. Thoseby.
 Temp. Capt. G. G. Timpson.
 Temp. Lieut.-Col. C. J. Trimble, C.M.G., V.D.
 Temp. Capt. H. S. Turner, M.C.
 Temp. Qmr. and Hon. Lieut. J. H. Turner.
 Capt. (Temp. Lieut.-Col.) W. Tyrrell, M.C. (Special Reserve).
 Temp. Capt. V. C. W. Vickers.
 Temp. Capt. C. D. Walker.
 Capt. J. Walker (Special Reserve).
 Temp. Capt. J. Walker.
 Temp. Capt. K. M. Walker.
 Capt. W. S. Wallace, M.C. (Special Reserve).
 Capt. G. D. Watkins, D.S.O.

Major J. W. West.
 Capt. J. B. Williamson (Special Reserve).
 Temp. Capt. F. E. S. Willis.
 Major (Temp. Lieut.-Col.) J. H. R. Winder.
 Major (Temp. Lieut.-Col.) M. G. Winder, D.S.O.
 Temp. Capt. F. B. Winfield.
 Temp. Capt. A. Wilson.
 Qmr. and Hon. Capt. W. Wilson.
 Capt. W. F. Wood, D.S.O., M.B. (Special Reserve).
 Temp. Capt. P. R. Woodhouse.
 Capt. (Acting Lieut.-Col.) F. Worthington, D.S.O.
 Temp. Capt. C. S. E. Wright.
 Lieut.-Col. A. O. B. Wroughton.
 No. 78605 Pte. S. W. Aitchison.
 No. 5022 Pte. (Acting Serjt.) F. Alden.
 No. 19882 Serjt. E. Arscott.
 No. 37604 Cpl. W. T. S. Austin.
 No. 67204 Pte. (Acting Qmr.-Serjt.) A. E. Bancroft.
 No. 495288 Pte. G. C. Bentley.
 No. 45533 Serjt. E. C. Berry.
 No. 411 Pte. (Acting Serjt.) C. G. Bowden.
 No. 68964 Cpl. (Acting Serjt.) H. Buckley.
 No. 65473 Pte. V. G. Burrows.
 No. 68136 Pte. H. H. Butterworth.
 No. 31037 Pte. (Acting Lance-Cpl.) F. Calver.
 No. 50328 Serjt. J. H. Campbell.
 No. 45731 Serjt.-Major W. Campbell.
 No. 92353 Pte. A. Carter.
 No. 31652 Staff-Serjt. H. C. Cartwright.
 No. 9257 Pte. R. W. Chapman (killed).
 No. 55195 Serjt. D. Charleson.
 No. 49688 Staff-Serjt. S. Cooper.
 No. 45555 Serjt.-Major L. A. Cronk.
 No. 66787 Serjt. G. W. Crook.
 No. 45564 Cpl. (Acting Serjt.) T. C. Curtis.
 No. 38630 Cpl. H. T. Dartnall.
 No. 31221 Staff-Serjt. F. Dawson.
 No. 19856 Pte. (Acting Serjt.) A. J. Dolder.
 No. 45324 Staff Serjt. J. G. Donaldson.
 No. 47919 Serjt. P. R. Duncan.
 No. 16879 Serjt. R. V. V. Egan.
 No. 35310 Cpl. (Acting Serjt.) W. Ellis.
 No. 10694 Pte. (Acting Serjt.) R. S. Ellwood.
 No. 17450 Staff Serjt. (Acting Qmr. Serjt.) W. J. Elsey.
 No. 10693 Pte. S. G. Evans.
 No. 47476 Pte. A. V. Fallon.
 No. 1464 Serjt. (Acting Qmr. Serjt.) J. Fitzgerald.
 No. 186 Serjt. W. G. Fream.
 No. 12248 Qmr. Serjt. (Temp. Serjt.-Major) W. Gamblen.
 No. 14452 Serjt. (Acting Staff Serjt.) F. Godfrey.
 No. 3657 Pte. A. Graham.
 No. 73745 Pte. (Acting Cpl.) A. W. Grattidge.
 No. 935 Staff Serjt. (Acting Qmr. Serjt.) H. M. Griffith-Williams.
 No. 31678 Serjt.-Major F. S. Hall.
 No. 19401 Staff Serjt. (Acting Serjt.-Major) A. E. Harland.
 No. 3984 Pte. T. Henderson.
 No. 12441 Serjt. Major L. Hubbard.
 No. 76948 Pte. H. W. Hunt.
 No. 40773 Pte. S. T. Hunt.
 No. 56912 Pte. (Acting Cpl.) T. Hunter.
 No. 30623 Serjt.-Major J. R. Ivins.

No. 66321 Serjt. Major F. W. Jeffries.
 No. 38809 Serjt. J. Jones.
 No. 11870 Serjt.-Major F. J. Loveland.
 No. 74724 Pte. (Acting Cpl.) F. W. Mercar.
 No. 47040 Staff. Serjt. D. Moffat.
 No. 6990 Pte. (Acting Serjt.) H. Montague.
 No. 61665 Pte. (Acting Cpl.) F. Morter.
 No. 40783 Cpl. F. C. Nelson.
 No. 16889 Cpl. (Acting Serjt.) S. Pain.
 No. 17620 Serjt.-Major G. W. Payne.
 No. 19267 Serjt. J. Peacock.
 No. 1607 Pte. (Acting Cpl.) W. T. Pond.
 No. 15288 Qmr.-Serjt. (Acting Serjt.-Major) W. C. Prince.
 No. 63643 Pte. T. S. Purcell.
 No. 9290 Pte. (Acting Lance-Cpl.) R. G. Read.
 No. 20623 Pte. (Acting Lance-Cpl.) T. L. Rimington.
 No. 18559 Staff-Serjt. (Acting Serjt.-Major) G. F. Rodgers.
 No. 118 Serjt. (Acting Qmr.-Serjt.) A. C. Rogers.
 No. 76043 J. Roles.
 No. 74026 Serjt. G. H. Sawyer.
 No. 792 Pte. (Acting Serjt.) F. Shearman.
 No. 103 Qmr.-Serjt. (Acting Serjt.-Major) G. P. Steer.
 No. 563 Pte. C. H. Stevens.
 No. 48071 Serjt.-Major W. Stroud.
 No. 49938 Qmr.-Serjt. N. Sumner.
 No. 189 Serjt. G. A. Taylor.
 No. 66771 Cpl. (Acting Serjt.) P. Taylor.
 No. 69092 Pte. W. Tomblin.
 No. 34259 Serjt. (Acting Qmr.-Serjt.) W. Uden.
 No. 49962 Staff-Serjt. (Acting Qmr.-Serjt.) P. Walmsley.
 No. 13317 Qmr.-Serjt. C. F. Wheeler.
 No. 39156 Pte. C. P. Wilkinson.
 No. 45672 Serjt. J. Woodcock.
 No. 46875 Serjt.-Major G. C. Yeatman.
 Temp. Major (Acting Lieut.-Col.) E. Alderson.
 Capt. J. G. Anderson.
 Major (Acting Lieut.-Col.) P. R. Ash.
 Capt. (Temp. Lieut.-Col.) J. Barkley.
 Major T. A. Barron.
 Acting Lieut.-Col. C. S. Brember.
 Capt. R. A. Broderick.
 Capt. A. S. Bruzard.
 Capt. D. Buchanan.
 Capt. (Acting Lieut.-Col.) H. N. Burroughes, M.B.
 Capt. F. C. Chandler.
 Capt. T. C. Clarke.
 Major (Temp. Lieut.-Col.) R. Coffey.
 Major (Temp. Lieut.-Col.) J. F. Crombie.
 Capt. J. Dale, M.B.
 Capt. W. H. Davison.
 Capt. (Acting Lieut.-Col.) H. G. W. Dawson.
 Major (Acting Lieut.-Col.) A. D. Ducat.
 Capt. J. Dundas.
 Capt. R. C. Dun.
 Qmr. and Hon. Major J. Dunn.
 Lieut.-Col. C. I. Ellis.
 Capt. A. H. Falkner.
 Capt. (Temp. Lieut.-Col.) A. T. Falwasser.
 Capt. (Temp. Major) J. D. Fiddes.
 Lieut.-Col. T. Fraser.
 Capt. H. J. B. Fry, M.D., B.Sc., M.R.C.S., L.R.C.P.
 Major (Acting Lieut.-Col.) H. Fulton.
 Temp. Capt. J. Gibson.

Major (Acting Lieut.-Col.) J. M. Gover.
 Capt. H. B. Graham.
 Capt. (Temp. Major, Acting Lieut.-Col.) T. A. Green.
 Temp. Capt. (Acting Lieut.-Col.) J. R. C. Greenlees, D.S.O.
 Capt. T. W. Hancock.
 Capt. H. Henry.
 Temp. Capt. W. J. Hirst.
 Capt. R. Jacobs.
 Major (Acting Lieut.-Col.) F. W. Johnson, M.B.
 Capt. A. E. Jury.
 Major (Temp. Lieut.-Col.) T. Kay.
 Capt. J. H. Lloyd.
 Major (Acting Lieut.-Col.) W. McCall.
 Capt. S. McCausland.
 Capt. J. S. Manford, M.B.
 Lieut.-Col. W. R. Matthews.
 Capt. S. S. Meighan.
 Major G. W. Miller.
 Major (Acting Lieut.-Col.) E. C. Montgomery-Smith, D.S.O.
 Capt. C. B. Moss-Blundell.
 Capt. J. C. Newman.
 Major (Acting Lieut.-Col.) J. Nightingale.
 Capt. H. S. Palmer.
 Capt. A. C. Pearson.
 Capt. J. Pinder.
 Capt. J. M. Plews.
 Capt. R. T. Raine.
 Capt. J. Ramsay.
 Capt. (Temp. Lieut.-Col.) J. Robertson.
 Major (Temp. Lieut.-Col.) W. F. Roe, D.S.O.
 Major J. S. Y. Rogers, D.S.O.
 Capt. F. A. Roper.
 Capt. (Temp. Lieut.-Col.) N. C. Rutherford, D.S.O., M.B., F.R.C.S.
 Capt. H. A. Sandiford.
 Capt. C. N. Smith.
 Capt. (Temp. Lieut.-Col.) S. M. Smith.
 Capt. W. Sneddon.
 Capt. E. S. Stork, D.S.O., M.B.

Capt. J. H. Thomas.
 Capt. (Temp. Major) A. C. F. Turner, D.S.O., M.B.
 Capt. D. L. Wall.
 Capt. F. H. C. Watson.
 Major (Temp. Lieut.-Col.) F. Whalley.
 Capt. F. W. White.
 Major (Temp. Lieut.-Col.) J. Wood.
 No. 545394 Staff-Serjt. A. W. Allison.
 No. 545379 Cpl. (Acting Staff-Serjt.) A. H. Bailey.
 No. 435001 Qmr.-Serjt. (Acting Serjt.-Major) J. Bode.
 No. 386196 Cpl. W. Clark.
 No. 339446 Serjt. H. Clemence.
 No. 341520 Qmr. A. N. Collinge.
 No. 350321 Pte. (Acting Lance-Cpl.) F. N. Cooling.
 No. 301230 Qmr.-Serjt. W. T. J. Davis.
 No. 435358 Pte. (Acting Lance-Cpl.) H. Evans.
 No. 337261 Staff-Serjt. L. Harrison.
 No. 512250 Qmr.-Serjt. E. A. Hopkins.
 No. 350002 Qmr.-Serjt. (Temp. Serjt.-Major) W. Jarman.
 No. 417055 Serjt.-Major A. King.
 No. 339006 Temp. Serjt.-Major D. G. Martin.
 No. 409033 Staff-Serjt. H. L. Moss.
 No. 390090 Pte. J. M. Nicholson.
 No. 301115 Lance-Serjt. G. C. Nicol.
 No. 439206 Serjt. H. A. Pelley.
 No. 461029 Pte. (Acting-Serjt.) A. Reed.
 No. 457027 Serjt. G. Rice.
 No. 459026 Shoeing-Smith Cpl. G. T. W. Roberts.
 No. 527541 Staff-Serjt. G. Shipley.
 No. 473007 Serjt. A. G. Shrubbs.
 No. 448039 Serjt. T. Slim.
 No. 303053 Qmr.-Serjt. J. Stables.
 No. 352193 Pte. D. Thompson.
 No. 540089 Pte. E. J. Turner.
 No. 421016 Serjt. H. L. Warner.
 No. 461217 Pte. C. E. Webb.

War Office,
 December 25, 1917.

REGULAR FORCES.

Army Medical Service.

The undermentioned Surgeon-Generals are placed on retired pay on having attained the age limit, dated December 26, 1917:—

Sir H. R. Whitehead, K.C.B., F.R.C.S.
 J. G. MacNeece, C.B.
 T. M. Corker, C.B., M.D.
 Sir D. Bruce, Kt., C.B., F.R.S., M.B., F.R.C.P.

Sir R. W. Ford, K.C.M.G., C.B., D.S.O.
 Sir T. P. Woodhouse, K.C.M.G., C.B.
 R. H. S. Sawyer, C.M.G., M.B., F.R.C.S.I.

The undermentioned Colonels are placed on retired pay on having attained the age limit, dated December 26, 1917:—

H. J. Barratt.
 H. O. Trevor.
 (Temp. Surg.-Gen.) J. M. Irwin, C.B., M.B., and is granted the hon. rank of Surgeon-General.
 C. E. Nichol, C.M.G., D.S.O. M.B.
 S. Westcott, C.B., C.M.G.
 (Temp. Surg.-Gen.) B. M. Skinner, C.M.G., M.V.O., and is granted the hon. rank of Surgeon-General.
 R. Kirkpatrick, C.B., C.M.G., M.D.
 E. H. L. Lynden Bell, C.B., M.B.

R. H. Firth, F.R.C.S.
 E. A. Tate, C.M.G.
 C. E. Faunce.
 R. J. Geddes, C.B., D.S.O., M.B.
 H. M. Sloggett.
 (Temp. Surg.-Gen.) J. Maher, C.B., and is granted the honorary rank of Surgeon-General.
 (Temp. Surg.-Gen.) G. D. Hunter, C.B., C.M.G., D.S.O., and is granted the honorary rank of Surgeon-General.
 C. Birt.

(Temp. Surg.-Gen.) R. D. F. Henderson, C.B., M.B., and is granted the honorary rank of Surgeon-General.
 (Temp. Surg.-Gen.) M. W. Russell, C.B., and is granted the honorary rank of Surgeon-General.
 (Temp. Surg.-Gen.) S. Hickson, C.B., M.B., and is granted the honorary rank of Surgeon-General.
 S. C. Philson.

J. H. Daly.
 M. J. Sexton, C.B., M.D.
 H. E. Cree.
 R. J. Windle, M.B.
 W. H. Horrocks, C.B., M.B.
 E. A. Burnside.
 C. R. Elliott, M.D.
 J. W. Bullen, M.D.
 R. Caldwell, F.R.C.S.
 C. A. Lane, M.B.

The undermentioned Colonels to be Surgeon-Generals, dated December 26, 1917 :—

(Temp. Surg.-Gen.) H. N. Thompson, C.M.G., D.S.O., M.D.
 W. T. Swan, C.B., M.D.
 G. Cree, C.B., C.M.G.
 H. Carr, C.B., M.D.

(Temp. Surg.-Gen.) A. A. Sutton, C.B., D.S.O.
 (Temp. Surg.-Gen.) M. T. Yarr, K.C.M.G., C.B., F.R.C.S.
 (Temp. Surg.-Gen.) C. H. Burtchaell, C.B., C.M.G., M.B.

The undermentioned Lieutenant-Colonels from Royal Army Medical Corps to be Colonels, dated December 26, 1917 :—

G. S. McLoughlin, C.M.G., D.S.O., M.B.
 W. W. O. Beveridge, C.B., D.S.O., M.B.
 Bt. Col. O. L. Robinson, C.M.G., K.H.P.
 H. J. M. Buist, D.S.O., M.B.
 G. B. Stanistreet, C.M.G., M.B.
 F. W. Begbie.
 (Bt. Col.) E. M. Pilcher, D.S.O., M.B., F.R.C.S.
 (Bt. Col.) W. G. Beyts.
 H. A. Hinge, C.M.G.
 H. A. Bray, C.M.G.
 E. W. Slayter, C.M.G.
 H. S. Thurston, C.M.G.
 T. P. Jones, C.M.G., M.B.
 G. A. Moore, C.M.G., M.D.
 E. H. Ondon, M.B.
 C. E. Pollock, D.S.O.
 F. R. Buswell, C.M.G.
 T. H. J. C. Goodwin, C.M.G., D.S.O.
 A. E. C. Keble, D.S.O.
 Bt. Col. D. J. Collins, M.D.

J. R. McMunn, C.M.G.
 H. V. Prynn, D.S.O., F.R.C.S.
 G. Dansey Browning.
 S. F. St. D. Green, M.D.
 P. Evans, C.M.G., M.B.
 C. K. Morgan, C.M.G., M.B.
 G. St. C. Thom, C.M.C., M.B.
 C. W. Profeit, D.S.O., M.B.
 F. Kiddle, C.M.G., M.B.
 R. J. Blackham, C.I.E., D.S.O.
 H. W. Grattan.
 (Bt. Col.) G. T. K. Maurice, C.M.G.
 J. V. Forrest, C.M.G., M.B.
 J. C. B. Statham, C.M.G.
 E. T. F. Birrell, C.B., C.M.G., M.B.
 E. W. Bliss, D.S.O.
 A. H. Morris.
 R. W. Clements, D.S.O., M.B.
 W. E. Hudleston, D.S.O.

Temp. Lieut.-Col. W. N. Barron, C.M.G., M.V.O., from Royal Army Medical Corps, to be Temporary Colonel, dated December 26, 1917.

The undermentioned Lieutenant-Colonels (Royal Army Medical Corps) are placed on retired pay on having attained the age limit, dated December 26, 1917 :—

T. B. Winter.
 A. T. I. Lilly.
 H. J. Fletcher, M.B.
 M. O'Halloran, M.B.
 W. E. Berryman.
 A. E. Morris, M.D.

C. T. Blackwell, M.D.
 H. H. Brown.
 R. Holyoake.
 H. E. Winter.
 (Bt. Col.) F. Smith, C.M.G., D.S.O.

TERRITORIAL FORCE.

Army Medical Service.

The undermentioned Colonels are placed on the Territorial Force Reserve, dated December 26, 1917 :—

S. S. Hoyland, M.D.
 E. C. Freeman, C.M.G., M.D.
 J. V. W. Rutherford, C.B.

de B. Birch, C.B., M.D.
 H. J. Mackay, M.D.
 C. E. Harrison, C.M.G., C.V.O., M.B., F.R.C.S.

The undermentioned Lieutenant-Colonels, from Royal Army Medical Corps (Territorial Force), to be Colonels, dated December 26, 1917 :—

A. W. Sheen, M.D.
 W. Ranson, D.S.O., F.R.C.S.
 H. E. B. Bruce Porter, C.M.G.

(Brevet Col.) A. M. Connell, F.R.C.S. Edin.
 A. D. Sharp, C.M.G., F.R.C.S.
 E. J. R. Evatt, M.B.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.,
January 1, 1918.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Honourable Order of the Bath, for valuable services rendered in connexion with Military Operations in the Field, dated January 1, 1918.

To be Additional Members of the Military Division of the Third Class, or Companions, of the said Most Honourable Order :—

Surg.-Gen. Richard Henry Stewart Sawyer, C.M.G., M.B. (retired pay), late Army Medical Service.

Col. Robert Hammill Firth, F.R.C.S., Army Medical Service.

Col. and Hon. Surg.-Gen. Bruce Morland Skinner, C.M.G., M.V.O., Army Medical Service.

Lieut.-Col. and Bt. Col. (Temp. Col.) Frederick Smith, C.M.G., D.S.O. (retired pay), late Royal Army Medical Corps.

Surg.-Gen. Henry Neville Thompson, C.M.G., D.S.O., M.B., Army Medical Service.

Col. Anthony John Luther, Army Medical Service.

Col. James Matthew Forrest Shine, Army Medical Service.

Col. James Barnett Wilson, C.M.G., M.D., Army Medical Service.

Col. Foster Reuss Newland, C.M.G., M.B., Army Medical Service.

Col. Hugh Champneys Thurston, C.M.G., Army Medical Service.

Temp.-Col. Alfred Herbert Tubby, C.M.G., M.B., F.R.C.S., Army Medical Service (Lieut.-Col. Royal Army Medical Corps (Territorial Force)).

Temp. Col. Sidney Maynard Smith, M.B., F.R.C.S., Army Medical Service (Capt. Royal Army Medical Corps (Territorial Force)).

Lieut.-Col. and Hon. Col. Charles Joseph Trimble, C.M.G., Territorial Force Reserve (Temp. Hon. Major Royal Army Medical Corps).

Lieut.-Col. (Acting Col.) Arthur Russell Aldridge, C.S.I., C.M.G., M.B., Reserve of Officers, Royal Army Medical Corps.

Col. Alexander Dunstan Sharp, C.M.G., F.R.C.S., Royal Army Medical Corps.

Lieut.-Col. (Temp. Col.) Thomas Finlayson Dewar, Royal Army Medical Corps.

Australian Force.

Col. Alfred Sutton, C.M.G., Australian Army Medical Corps.

New Zealand Force.

Col. Charles Mackie Begg, C.M.G., M.D., F.R.C.S., M.R.C.P., New Zealand Medical Corps.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
January 1, 1918.

The King has been graciously pleased to give directions for the following promotions in, and appointments to, the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with Military Operations in the Field, dated January 1, 1918 :—

To be an Additional Member of the First Class, or Knight Grand Cross, of the said Most Distinguished Order :—

Temp. Surg.-Gen. Sir George Henry Makins, K.C.M.G., C.B., F.R.C.S.

To be Additional Members of the Second Class or Knights Commanders, of the said Most Distinguished Order :—

Surg.-Gen. William Grant Macpherson, C.B., C.M.G., M.B., Army Medical Service.

Col. and Hon. Surg.-Gen. James Murray Irwin, C.B., M.B. (retired pay), late Army Medical Service.

Col. and Hon. Surg.-Gen. James Maher, C.B. (retired pay), late Army Medical Service.

Temp. Col. James Purves Stewart, C.B., M.D., F.R.C.P., Army Medical Service.

Temp. Col. Thomas Crisp English, C.M.G., M.B., F.R.C.S., Army Medical Service.

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order :—

Col. Philip Cecil Harcourt Gordon, Army Medical Service.

Col. Charles Joseph MacDonald, M.D., Army Medical Service.

Col. Edward George Browne, C.B., Army Medical Service.

Col. Samuel Guise Moores, C.B., Army Medical Service.

Lieut.-Col. and Bt. Col. (Temp. Col.) Howard Ensor, D.S.O., M.B., Royal Army Medical Corps.

Temp. Col. (Lieut.-Col. R.A.M.C., T.F.) William Pasteur, M.D., Army Medical Service.

Lieut.-Col. (Temp. Col.) Daniel Davis Shanban, D.S.O., Royal Army Medical Corps.

Col. Ernest William Bliss, D.S.O., Army Medical Service.

Col. Alfred Ernest Conquer Keble, D.S.O., Army Medical Service.

Temp. Hon. Lieut.-Col. Nathan Raw, M.D., Royal Army Medical Corps.

Col. Charles William Profeit, D.S.O., M.B., Army Medical Service.

Col. Robert James Blackham, C.I.E., D.S.O., R.F.P.S., Army Medical Service.

Temp. Lieut.-Col. Ernest Henry Starling, M.D., F.R.C.P., F.R.S., Royal Army Medical Corps.
 Temp. Lieut.-Col. Leonard Stanley Dudgeon, F.R.C.P., Royal Army Medical Corps.
 Lieut.-Col. Clarence Isidore Ellie, Royal Army Medical Corps.

Australian Force.

Col. George Walter Barber, D.S.O., Army Medical Corps.
 Col. Robert Rupert Major Downes, Army Medical Corps.
 Lieut.-Col. (Temp. Col.) Arthur Thomas White, Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace,
 January 1, 1918.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Honourable Order of the Bath, for services rendered in connexion with the War, dated January 1, 1918.

To be additional Member of the Military Division of the Second Class, or Knight Commander, of the said Most Honourable Order :—

Surg.-Gen. Sir David Bruce, C.B., F.R.S., F.R.C.P., M.B., retired pay, late Army Medical Service.

To be Additional Members of the Military Division of the Third Class, or Companions of the said Most Honourable Order :—

Surg.-Gen. Francis John Jencken, M.B., Army Medical Service.

Col. William Coates, C.B. (Civil), Royal Army Medical Corps (T.F.Res., retired).

Temp. Col. (Lieut.-Col. Royal Army Medical Corps (Territorial Force)) Howard Henry Tooth, C.M.G., M.D., Army Medical Service.

Temp. Hon. Lieut.-Col. George Seaton Buchanan, M.D., Royal Army Medical Corps.

Temp. Lieut.-Col. Andrew Balfour, C.M.G., M.D., F.R.C.P., Royal Army Medical Corps.

Major and Brevet Lieut.-Col. Robert Markham Carter, Indian Medical Service.

Canadian Force.

Col. Frederick Gault Finley, Canadian Army Medical Service.

CHANCERY OF THE ORDER OF ST. MICHAEL AND ST. GEORGE.

Downing Street,
 January 1, 1918.

The King has been graciously pleased to give directions for the following promotions in, and appointments to, the Most Distinguished Order of St. Michael and St. George, in recognition of valuable services in connexion with the War, dated January 1, 1918 :—

To be Additional Members of the Second Class, or Knights Commanders, of the said Most Distinguished Order :—

Temp. Col. Archibald Edward Garrod, C.M.G., M.D., F.R.S., Army Medical Service.

Col. and Hon. Surg.-Gen. Michael William Russell, C.B., retired pay, late Army Medical Service.

Temp. Col. Charles Alfred Ballance, C.B., M.V.O., M.B., F.R.C.S., Army Medical Service.

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order :—

Col. Joseph Griffiths, M.D., F.R.C.S., Royal Army Medical Corps (Territorial Force).

Col. Charles Pye Oliver, M.D., K.H.P., Royal Army Medical Corps.

Col. Charles Henderson Melville, M.B., Army Medical Service.

Temp. Hon. Col. Sir John Collie, M.D., Army Medical Service.

Lieut.-Col. Arthur de Courcy Scanlan, retired pay, Reserve of Officers, Royal Army Medical Corps.

Temp. Hon. Lieut.-Col. Harry Richard Kenwood, M.B., Royal Army Medical Corps (Major, Royal Army Medical Corps (Territorial Force)).

Temp. Hon. Lieut.-Col. John Robertson, M.D., Royal Army Medical Corps.

Temp. Lieut.-Col. John Charles Grant Ledingham, M.B., Royal Army Medical Corps.

Temp. Lieut.-Col. Charles Morley Wenyon, M.B., Royal Army Medical Corps.

Temp. Lieut.-Col. George Basil Price, M.D., Royal Army Medical Corps.

Lieut.-Col. Henry Stewart Anderson, Royal Army Medical Corps.

Major Thomas Wardrop Griffith, M.D., Royal Army Medical Corps.

Lieut.-Col. (Hon. Surg.-Col.) (Temp. Col.) William Mitchell Roccoft, Royal Army Medical Corps.

Australian Force.

Lieut.-Col. John Gordon, Army Medical Corps.

Lieut.-Col. (Temp. Col.) Douglas Murray McWhae, Army Medical Corps.

Hon. Lieut.-Col. James Anderson Murdoch, Army Medical Corps.

Lieut.-Col. (Temp. Col.) Kenneth Smith, Army Medical Corps.

Canadian Force.

Col. Kenneth Cameron, Army Medical Corps.
 Col. George Septimus Rennie, Army Medical Corps.
 Col. Wallace Arthur Scott, Army Medical Corps.
 Col. Walter Langmuir Watt, Army Medical Corps.
 Major (Acting Lieut.-Col.) John Andrew Amyot, Army Medical Corps.

New Zealand Forces.

Major (Temp. Lieut.-Col.) Thomas Mill, M.B., F.R.C.S., Medical Corps.

War Office,
 January 1, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for Distinguished Service in the Field, dated January 1, 1918.

TO BE BREVET COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Lieut.-Col. (Temp. Col.) H. E. M. Douglas, V.C., C.M.G., D.S.O., Royal Army Medical Corps.
 Lieut.-Col. (Temp. Col.) J. Poe, D.S.O., M.B., Royal Army Medical Corps.

TO BE BREVET LIEUTENANT-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Royal Army Medical Corps.

Major R. T. Brown, D.S.O., M.B.	Major (Temp. Lieut.-Col.) S. L. Pallant, D.S.O.
Major (Acting Lieut.-Col.) B. R. Dennis, M.B.	Major (Temp. Lieut.-Col.) M. G. Winder, D.S.O.
Major (Acting Lieut.-Col.) G. W. G. Hughes, D.S.O.	
Major J. T. Johnson, D.S.O., M.D.	Major R. McCarrison, M.B., Indian Medical Service.
Major (Temp. Lieut.-Col.) A. McMunn.	

TO BE BREVET MAJOR.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Royal Army Medical Corps.

Capt. (Acting Lieut.-Col.) G. H. Dive, D.S.O.	Capt. A. S. N. Macgregor.
Temp. Capt. N. Duggan, M.B., F.R.C.S.	Temp. Capt. H. F. Marris, M.B.
Capt. R. C. Dun.	Capt. (Temp. Major) K. W. Monsarrat, M.B., F.R.C.S.
Capt. G. W. Ellis.	Capt. G. Patton.
Capt. W. R. Galwey, M.C., M.B.	Capt. (Acting Lieut.-Col.) P. S. Tomlinson.
Capt. A. D. Griffith, M.D., F.R.C.S.	
Capt. (Temp. Lieut.-Col.) R. E. Kelly, M.D., F.R.C.S.	

War Office,
 January 1, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned Honours and Rewards for valuable services rendered in connexion with the War, dated January 1, 1918:—

TO BE BREVET COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Royal Army Medical Corps.

Major and Brevet Lieut.-Col. J. S. Bostock, M.B.	Lieut.-Col. T. B. A. Tuckey, retired pay.
Lieut.-Col. R. J. C. Cottell, retired pay.	
Lieut.-Col. T. W. O'H. Hamilton, C.M.G., M.B., retired pay, Reserve of Officers.	Lieut.-Col. J. J. Pratt, retired pay, Indian Medical Service.
Lieut.-Col. P. H. Johnston, C.M.G., M.D., retired pay.	Lieut.-Col. S. J. Thomson, C.I.E., retired pay, Indian Medical Service.
Lieut.-Col. C. W. M. Moullin, M.D., F.R.C.S.	

TO BE BREVET LIEUTENANT-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories as applicable.)

Royal Army Medical Corps.

Major (Acting Lieut.-Col.) J. C. Furness, Special Reserve.	Major C. G. Spencer, M.B., F.R.C.S., retired pay, Reserve of Officers.
Major T. W. Griffith, M.D.	Major W. K. Steele, Special Reserve.
Major H. Jones.	Major (Local Lieut.-Col.) A. Wright, retired pay, Reserve of Officers.
Major F. W. Mott, M.D., F.R.C.P., F.R.S.	
Major H. J. Parry, D.S.O., M.B., Reserve of Officers.	Major W. E. A. Armstrong, retired, Indian Medical Service.

TO BE BREVET MAJOR.

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories as applicable.)

Capt. H. G. Gibson, Royal Army Medical Corps.

Capt. (Temp. Major) E. W. H. Groves, M.D., F.R.C.S., Royal Army Medical Corps.

Capt. (Temp. Lieut.-Col.) H. J. Stiles, M.B., F.R.C.S., Royal Army Medical Corps.

TO BE HONORARY LIEUTENANT-COLONEL.

Qmr. and Hon. Major A. Bruce, retired pay, Royal Army Medical Corps.

Qmr. and Hon. Major D. J. Gillman, Royal Army Medical Corps.

Qmr. and Hon. Major H. G. Hasell, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for Distinguished Service in the Field, dated January 1, 1918:—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. (Acting Lieut.-Col.) James Robertson Campbell Greenlees, D.S.O., M.B., Royal Army Medical Corps.

Major (Temp. Lieut.-Col.) William Moore Bell Sparkes, D.S.O., Royal Army Medical Corps.

Capt. (Acting Lieut.-Col.) Frank Worthington, D.S.O., M.B., Royal Army Medical Corps.

AWARDED THE DISTINGUISHED SERVICE ORDER.*Royal Army Medical Corps.*

Capt. (Acting Lieut.-Col.) Edmund Alderson,
M.D.

Temp. Capt. John Anderson.

Lieut.-Col. (Temp. Col.) Harold Percy Waller
Barrow, C.M.G.

Capt. (Temp. Lieut.-Col.) Francis Lyndon
Bradish.

Capt. (Acting Lieut.-Col.) Frederick Hoysted
Bradley, M.B.

Capt. (Acting Lieut.-Col.) Charles Stuart
Brebner, M.D.

Temp. Capt. (Acting Lieut.-Col.) Christopher
Victor Bulstrode, M.B.

Capt. Thomas Carnwath, M.B.

Lieut.-Col. Edward Webber Warren Cochrane,
M.B.

Major (Acting Lieut.-Col.) Richard Coffey.

Major (Temp. Lieut.-Col.) Reginald Thomas
Collins.

Major (Temp. Lieut.-Col.) John Frank Crombie.

Temp. Lieut.-Col. John Edward Henry Davies.

Major (Temp. Lieut.-Col.) Norman Edwin
Dunkerton.

Capt. (Acting Lieut.-Col.) William Egan, M.B.

Temp. Lieut.-Col. Thomas Renton Elliott.

Capt. (Acting Lieut.-Col.) Thomas Swan Eves,
M.B.

Capt. Harold Arthur Thomas Fairbank,
F.R.C.S.

Capt. (Temp. Major) Arthur Wellesley Fal-
coner, M.D.

Capt. (Temp. Lieut.-Col.) Arthur Thomas
Falwasser.

Major (Acting Lieut.-Col.) David Leonard
Fisher, M.B.

Lieut.-Col. Thomas Fraser, M.B.

Capt. (Acting Lieut.-Col.) William Ross
Gardner, M.B., Special Reserve.

Capt. Eric Gerald Gauntlett, M.B.

Capt. Alexander John Gibson, Special Reserve.

Capt. John Galbroath Gill, M.C., M.B.

Major (Acting Lieut.-Col.) John Maxwell
Gover, M.B.

Lieut.-Col. (Temp. Col.) Henry William
Grattan.

Capt. Alfred George Hebblethwaite.

Lieut.-Col. (Temp. Col.) Harry Alexander
Hinge, C.M.G.

Lieut.-Col. (Temp. Col.) John William Hobart
Houghton, M.B.

Capt. Basil Hughes, M.B., F.R.C.S.

Major (Temp. Lieut.-Col.) Rochford Noel
Hunt, M.B.

Capt. (Acting Lieut.-Col.) Edward James
Kavanagh, M.C., M.B.

Major (Temp. Lieut.-Col.) Thomas Kay, M.B.

Major (Temp. Lieut.-Col.) Gerard Ainslie
Kempthorne.

Capt. (Acting Lieut.-Col.) John Du Plessis
Langrishe, M.B.

Capt. Stanley Dermott Large, M.C.

Major (Acting Lieut.-Col.) Alexander Leggat,
M.B.

Major (Acting Lieut.-Col.) William McCall,
M.B.

Capt. William McKim Herbert McCullagh,
M.C., M.B., Special Reserve.

Temp. Capt. Gordon Archibald McLarty, M.B.

Capt. John William McNee, M.B., Special
Reserve.

Capt. (Acting Lieut.-Col.) John Alexander
Manifold, M.B.

Temp. Lieut.-Col. William Riddell Matthews.

Major (Temp. Lieut.-Col.) Sydney Manvers
Woolner Meadows.

Capt. George Waterston Miller.

Lieut.-Col. (Temp. Col.) George Abraham Moore, C.M.G.
 Major (Acting Lieut.-Col.) Thomas Bettesworth Moriarty.
 Capt. George Singleton Parkinson.
 Lieut.-Col. (Temp. Col.) Frederick Septimus Penny, C.M.G., M.B.
 Capt. (Acting Lieut.-Col.) Ernest Cyril Phelan, M.B.
 Capt. (Acting Lieut.-Col.) Alexander Morton Pollard.
 Lieut.-Col. Edgar Elkin Powell.
 Temp. Capt. John Frederick Gwyther Richards, M.B.
 Capt. (Acting Lieut.-Col.) John Walter Lennox Scott.
 Major (Temp. Lieut.-Col.) Henry Francis Shea, M.B.
 Lieut.-Col. (Temp. Col.) Edward Wheeler Slayter, C.M.G.
 Capt. Alexander Dickson Stirling, M.B.
 Temp. Capt. Adrian Stokes, M.D., F.R.C.S.
 Capt. (Acting Lieut.-Col.) George Pritchard Taylor, M.C., M.B.
 Capt. James Hugh Thomas, M.B.

Capt. (Temp. Lieut.-Col.) William Irwin Thompson, M.B.
 Major (Acting Lieut.-Col.) Wentworth Francis Tyndale, C.M.G., M.D.
 Major Ernest Blechynden Waggett, M.B.
 Major (Acting Lieut.-Col.) Joseph Ward.
 Major George William Webb Ware, M.B.
 Major (Temp. Lieut.-Col.) Frederick Whalley, M.B.
 Major (Temp. Lieut.-Col.) Charles Richardson White, M.B.
 Major (Acting Lieut.-Col.) James Herbert Roche Winder, M.D.
 Major (Temp. Lieut.-Col.) James Wood.
 Capt. (Acting Lieut.-Col.) Andrew Rae Wright, M.B.
 Lieut.-Col. Arthur Oliver Bird Wroughton.
 Major (Temp. Lieut.-Col.) Peter Skinner Clarke, South African Medical Corps.
 Capt. Thomas Spence Dunn, East African Medical Service.
 Lieut.-Col. Archibald Nicol Fleming, M.B., F.R.C.S., Indian Medical Service.

Australian Force.

Major Alan Sinclair Durvall Barton, Army Medical Corps.
 Lieut.-Col. James Jamison Black, Army Medical Corps.
 Major David Duncan Cade, Army Medical Corps.
 Major Clement Lorne Chapman, Army Medical Corps.
 Lieut.-Col. Michael Henry Downey, Army Medical Corps.
 Major Roy Stanley McGregor, Army Medical Corps.

Lieut.-Col. Arthur Henry Moseley, Army Medical Corps.
 Lieut.-Col. Henry Simpson Newland, Army Medical Corps.
 Major John Joseph Power, Army Medical Corps.
 Lieut.-Col. John Mitchell Young Stewart, Army Medical Corps.
 Major Claude John Tozer, Army Medical Corps.
 Temp. Lieut.-Col. Charles Ernest Wassell, Army Medical Corps.
 Major Henry James Williams, Army Medical Corps.

Canadian Force.

Major (Acting Lieut.-Col.) Alfred Turner Bazin, Army Medical Corps.
 Major (Acting Lieut.-Col.) Percy George Bell, Army Medical Corps.
 Lieut.-Col. James Edgar Davey, Army Medical Corps.
 Lieut.-Col. Charles Harold Dickson, Army Medical Corps.
 Major (Acting Lieut.-Col.) James Johnston Fraser, Army Medical Corps.

Temp. Lieut.-Col. Thomas McEae Leask, Army Medical Corps.
 Major George Sidney Mothersill, Army Medical Corps.
 Lieut.-Col. Thomas Joseph Francis Murphy, Army Medical Corps.
 Lieut.-Col. (Temp. Col.) Charles Ayre Peters, Army Medical Corps.
 Major (Temp. Lieut.-Col.) Clifford Hamilton Reason, Army Medical Corps.

New Zealand Force.

Major Frederick Cameron, M.B., New Zealand Medical Corps.

Lieut.-Col. Charles Treweeki Hand Newton M.D., F.R.C.S., New Zealand Medical Corps.

South African Force.

Temp. Capt. Hugh Brindley Owen, M.B., Uganda Medical Service.
 Major David Morris Tomory, South African Medical Corps.

Lieut.-Col. Arthur Blackwood Ward, M.B., South African Medical Corps.

AWARDED A BAR TO THE MILITARY CROSS.

Royal Army Medical Corps.

Temp. Capt. Robert Briffault, M.C., M.B.
 Temp. Capt. Maurice Smith Bryce, M.C., M.B.
 Temp. Capt. George Beatty Burwell, M.C., M.B.

*Temp. Capt. James Macgregor, M.C., M.D.
 Temp. Capt. Bernard Charles Tennent, M.C., M.D.

Note.—In the case marked by an asterisk the announcement of award of the Military Cross has not yet been published in the *London Gazette*; this reward will be published early this month.

AWARDED THE MILITARY CROSS.

Royal Army Medical Corps.

- Temp. Lieut. Ernest Haik Riddall Altonunyan M.B.
 Capt. John George Anderson.
 Qmr. and Hon. Lieut. James Edward Hill Anderton.
 Temp. Capt. Robert Richmond Archibald, M.B.
 Temp. Capt. Bertram Friend Bartlett.
 Temp. Capt. Maurice Frederick Bliss.
 Temp. Capt. Philip Rutherford Boswell.
 Capt. Charles Gordon Brentnall, M.B.
 Capt. Charles Dudley Maybury Buckley, Special Reserve.
 Temp. Capt. Angus Campbell.
 Temp. Capt. George Maclean Campbell, M.B.
 Capt. Neil Cantlie, M.B.
 Temp. Capt. William Tregonwell Collier.
 Temp. Capt. Ronald Campbell Cooke.
 Temp. Capt. Alexander Kirkpatrick Cosgrave, M.B.
 Capt. Thomas Joseph Costello, M.B.
 Temp. Capt. John Polson Davidson, M.B.
 Capt. Thomas McNaughton Davie, Special Reserve.
 No. 17833 Serjt.-Major David Edward Dean.
 Temp. Capt. Henry Speldewinde de Boor.
 Capt. Ian Dunbar Dickson, M.D., Special Reserve.
 Lieut. William Donald, M.B., Special Reserve.
 Temp. Capt. Joseph Haslett Elliott, M.D.
 Temp. Capt. Herbert Emerson, M.B.
 Temp. Capt. John Caldwell Fergusson.
 Temp. Capt. Lawrence Unthank Geraty.
 Qmr. and Hon. Lieut. Arthur Ernest Glass.
 Temp. Capt. Edward Gordon (R. Highlanders).
 Capt. Frederick James Green, M.D.
 Capt. (Temp. Major) William Wells Greer, M.D., F.R.C.S.
 Capt. John Cauldwell Grieve.
 Temp. Capt. Leonard Leith Hadley, M.D.
 Capt. Alfred Christopher Hammond-Searle.
 Temp. Capt. John Fearby Campbell Haslam, M.B.
 Temp. Capt. Arthur Joseph Hawes.
 Temp. Capt. Harold Granwell Aloysius Haynes.
 Temp. Capt. Hugh George Hobson.
 Temp. Capt. Gerald Holroyde.
 Capt. Leslie Edward Hughes.
 Temp. Capt. John Nelson Humphrey, M.B.
 Temp. Capt. Douglas Macinnes Hunter, M.B.
 Temp. Capt. David Lindsay Hutton.
 Capt. Thomas Douglas Inch, M.B. (Special Reserve).
 Capt. Tom Ramsden Kenworthy.
 Temp. Capt. Alick Edmund Knight, M.B.
 Temp. Capt. Alexander Campbell White Knox, M.B.
 Capt. William Henry Laslett, M.B.
 Temp. Capt. Alec Antony Lees.
 Capt. Reginald Heber Leigh, Special Reserve.
 Temp. Capt. Kenneth Thomas Limbery.
 Temp. Capt. Percy Collins Litchfield.
 Temp. Capt. Conrad Loddiges.
 Capt. Norman Veitch Lothian, M.B.
 Temp. Capt. Reginald Hutchison Lucas.
 Temp. Capt. William McConnell, M.B.
 Capt. Thomas McEwen, Special Reserve.
 Temp. Capt. John Mandeville MacFie, M.B.
 Temp. Capt. William Keverall McIntyre, M.B.
 Temp. Capt. Magnus Ross Mackay, M.B., attached R.F.A.
 Capt. Kenneth MacLennan.
 Capt. Frank Douglas Marsh.
 Temp. Capt. Eric Stewart Marshall.
 Temp. Capt. James Frederick Matheson, M.B.
 Qmr. and Hon. Lieut. John Hannaford Maunder.
 Capt. John Miller.
 Temp. Capt. Montagu Travers Morgan, attached K. A. Rifles.
 Temp. Capt. Reginald Sperling Morshead, M.B.
 Capt. William Murdoch, M.B., Special Reserve.
 Capt. Charles William Chester Myles, M.B.
 Temp. Capt. Guy William Parry.
 Temp. Lieut. Richard Douglas Passey, M.B., attached K.R.R.C.
 Temp. Capt. Montgomery Paterson Paton, M.B.
 Lieut. (Temp. Capt.) John Hawkes Pendered, M.B., F.R.C.S.
 Capt. Ivor Miller Pirrie, M.B.
 Capt. Robert Elliott Pitts.
 Capt. Harvey Forshaw Plant, R.F.A.
 Capt. Leopold Thomas Poole, M.B.
 Capt. William Latto Robertson, M.B., Field Ambulance.
 Capt. Cecil John Rogerson, M.B., Special Reserve.
 Temp. Capt. Gordon Wilfred Ritchie Rudkin.
 Capt. Edmund Uniacke Russell.
 Temp. Capt. Walter Henderson Scott, attached D.L.I.
 Temp. Capt. Leslie Henderson Skene, M.B.
 Capt. Evelyn Charles Sprawson.
 Capt. Cecil Spurling Staddon, Special Reserve.
 Qmr. and Hon. Lieut. James Thomas Starkie.
 Capt. James Sawn, M.B., Special Reserve.
 Temp. Capt. Henry John Hugh Symons.
 Temp. Capt. George Lostock Thornton.
 Qmr. and Hon. Capt. Thomas John Tilbrook.
 Temp. Capt. Robert Tindall, M.B.
 Capt. Alan Leonard Smith Tuke, M.B.
 Capt. Bernard Varvill.
 Capt. Edmund Wayne Vaughan, M.B.
 Capt. Joseph Walker, M.B., Special Reserve.
 Temp. Capt. Edward Chapman Wallace.
 Capt. Joseph Hugh Ward, M.B., Special Reserve.
 Qmr. and Hon. Capt. Herbert Ernest Balfern Ware.
 Temp. Capt. Hugh Fleming Warwick, M.B.
 Temp. Capt. Gwilym David Watkins, D.S.O.
 Temp. Capt. John Dalglish Watson.
 Temp. Capt. William Barrie Watson, M.B.
 Capt. William Joseph Webster, M.B., Special Reserve.
 Temp. Capt. Llewellyn McIntyre Weeks.
 Temp. Capt. George Plunkett White, M.D.
 Temp. Capt. Alan Wilson, M.B.
 Capt. Alexander Frazer Wilson, M.D.
 Capt. William Fothergill Wilson, M.B.
 Temp. Capt. Charles Witts, M.B.
 Capt. William Vincent Wood, Territorial Force.

Capt. Haji Sulaiman Gulam-hossein Haji, Indian Medical Service. | Capt. James Maurice Roche, M.B., Indian Medical Service.

Australian Force.

Capt. Keith McKeddie Doig, Australian Army Medical Corps. | Qmr. and Hon. Capt. John Francis Murray, Australian Army Medical Corps.
 Capt. George Stephenson Elliott, Australian Army Medical Corps. | Capt. (now Major) Ernest Kent Parry, Australian Army Medical Corps.
 Capt. (now Major) Wilfred Evans, Australian Army Medical Corps. | Capt. Colin Coape Simson, Australian Army Medical Corps.
 Capt. Challenger George Farmer, Australian Army Service Corps. | Capt. Robert Marriott William Webster, Australian Army Medical Corps.
 Capt. (now Major) Richard Hastings Hudson, Australian Army Medical Corps. | Qmr. and Hon. Capt. Richard Packer Wheeler, Australian Army Medical Corps.
 Capt. Henry Fitzgerald Maudsley, Australian Army Medical Corps.

Canadian Force.

Capt. Herbert Charles Allison, Canadian Army Medical Corps. | Capt. (now Major) Arthur Llewellyn Jones, Canadian Army Medical Corps.
 Capt. Charles Philip Fenwick, Canadian Army Medical Corps. | Capt. Harry Wishart Wythock, Canadian Army Medical Corps.
 Capt. Robert John Gardiner, Canadian Army Medical Corps. | Capt. Richard Todd Wilson Herald, Canadian Army Medical Corps.
 Capt. Richard Todd Wilson Herald, Canadian Army Medical Corps.

New Zealand Force.

Capt. William Gillers Borrie, M.B., New Zealand Medical Corps. | Capt. Frederick Noel Johns, M.B., New Zealand Medical Corps.
 Capt. (now Major) John Connor, M.B., New Zealand Medical Corps. | Capt. Joseph Kendrick Venables, New Zealand Medical Corps.
 Capt. Kenneth Farquharson Gordor, New Zealand Medical Corps.

South African Force.

Capt. Ernest Hill, South African Medical Corps.

Note.—Since the list of rewards (announced in the *Gazette*) was placed in the hands of the printers, a number of officers have been advanced in permanent, temporary or acting rank, and in some cases temporary or acting rank has been relinquished, but it has not been found practicable to make the necessary changes in description in the *Gazette*.

AWARDED DISTINGUISHED CONDUCT MEDAL.

Royal Army Medical Corps.

No. 25789 Serjt. H. Bottomley (Colchester). | No. 35078 Staff Serjt. (Acting Serjt.-Major) T. McNicol (Derby).
 No. 6146 Pte. (Acting Serjt.) J. Hughes (Manchester). | No. 20788 Cpl. (Acting Serjt.) J. Moran (Longsight, Manchester).
 No. 18576 Qmr.-Serjt. (Acting Serjt.-Major) W. Lamkin (Ventnor, I. of W.). | No. 54483 Serjt. W. Price (Brookend, Glouc.).
 No. 18216 Qmr.-Serjt. (Acting Serjt.-Major) R. G. Leggett (Aldershot).

MERITORIOUS SERVICE MEDAL.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, in recognition of valuable services rendered with the Armies in the Field during the present War:—

Royal Army Medical Corps.

No. 530 Serjt. A. Adams (Netley). | No. 31641 Serjt.-Major J. Brett (Plumstead).
 No. 12986 Staff-Serjt. E. Alexander (Jersey). | No. 14770 Qmr.-Serjt. (Acting Serjt.-Major) A. Buckner (Glasgow).
 No. 354180 Serjt. J. H. Ashton (Manchester). | No. 13027 Serjt.-Major J. B. Cantrell (Warrington).
 No. 350097 Serjt. N. Ashworth (Bolton). | No. 40469 Pte. E. L. Cartwright (Birmingham).
 No. 31601 Staff-Serjt. J. G. Batten (St. Helens). | No. 57419 Qmr.-Serjt. W. H. Daniels (Linthorpe).
 No. 36490 Serjt.-Major D. J. D. Belford (Dundee).
 No. 764 Staff Serjt. R. Boddy (Cardiff).
 No. 512426 Serjt. E. S. Bourton (Brixton).

- No. 51398 Qmr.-Serjt. D. . Davies (West Ealing).
 No. 16115 Serjt.-Major E. B. Dewberry (Cambridge).
 No. 56731 Serjt. (Acting Qmr.-Serjt.) T. C. Durnan (Sheffield).
 No. 19322 Staff-Serjt. (Acting Qmr.-Serjt.) H. Elliott (Liverpool).
 No. 30754 Qmr.-Serjt. H. E. Fawden (Bristol).
 No. 435295 Cpl. L. T. Fontaine (Birmingham).
 No. 14924 Staff-Serjt. (Acting Serjt.-Major) J. G. A. Forbes (Edinburgh).
 No. 12890 Serjt.-Major J. S. Gardiner (York).
 No. 350235 Serjt. W. Glover, attached R.A.M.C. (Manchester).
 No. 356018 Serjt. (Acting Staff-Serjt.) J. H. Griffiths (Manchester).
 No. 421333 Serjt. H. A. Harper (Wolverhampton).
 No. 19563 Staff-Serjt. (Acting Qmr.-Serjt. H. Harrington (Brighton).
 No. 11841 Temp. Serjt.-Major S. R. Holmes (Wednesbury).
 No. 12732 Temp. Serjt. - Major F. Hughes (Birmingham).
 No. 18383 Staff-Serjt. (Acting Serjt.-Major) W. Hutchings (Enfield).
 No. 17409 Serjt.-Major H. Kimberley.
 No. 19256 Serjt. W. King (Sutton, Surrey).
 No. 301035 Qmr.-Serjt. (Acting Serjt.-Major) J. Leslie (Aberdeen).
 No. 38885 Serjt.-Major G. A. Medlock (Bolton-on-Dearne).
 No. 39854 Serjt.-Major F. Miller (Acton).
 No. 341099 Staff-Serjt. (Acting Serjt.-Major) J. Parr (St. Helens).
 No. 405051 Serjt. A. Pattison (Sheffield).
 No. 49923 Staff-Serjt. A. Pearson (Swinton).
 No. 337005 Qmr.-Serjt. T. H. Potter (Tuebrook, Liverpool).
 No. 39975 Serjt. L. A. Pratt (Kirklington).
 No. 5102 Corpl. (Acting Serjt.) J. O. Randle (Leicester).
 No. 497548 Qmr.-Serjt. C. A. Scarbrow (Hanwell).
 No. 1764 Serjt. H. W. Selden (Lincoln).
 No. 49668 Cpl. (Acting Serjt.) E. C. Tansley (Coventry).
 No. 39950 Serjt.-Major A. Thompson (Manchester).
 No. 18657 Staff-Serjt. (Acting Serjt.-Major) V. Tripp (Clapton).
 No. 41241 Serjt. W. J. Turner (Lurgan, Co. Armagh).
 No. 417251 Cpl. (Acting Serjt.) F. V. Warden (Derby).
 No. 419002 Qmr.-Serjt. (Acting Serjt.-Major) T. Wheway (Leicester).
 No. 400088 Qmr.-Serjt. H. White (Walsall).
 No. 46986 Cpl. (Serjt.) W. Wignall (Liverpool).
 No. 18454 Qmr.-Serjt. (Acting Serjt.-Major) F. A. Philbrook, R.E. (E) (Swindon).

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

At the conclusion of the first complete year of the existence of the Auxiliary Royal Army Medical Corps Funds it is thought that all officers of the Auxiliary Forces will be interested to hear something of the measure of success which has been attained in promoting the objects for which the funds were established.

Initiated by the Director-General, Surgeon-General Sir Alfred Keogh, G.C.B., in June, 1916, the idea soon began to take shape and a committee was formed in August which undertook the management of the funds subject to the approval of the Annual General Meeting.

Circulars were sent out to all officers and subscriptions invited, first from officers of the Auxiliary Forces, for the Benevolent Branch for the assistance of orphans of deceased officers who may have left their families in difficult circumstances, with a view to obtaining for the children a better education than would have otherwise been possible: and secondly from Canteen and Recreation Funds for the Relief Branch for the immediate needs of widows and orphans of soldiers of the Corps of the new armies who have lost their lives during the War.

All moneys received have been banked separately in the two branches, the accounts being kept quite distinct, and a considerable proportion of each invested in Government securities.

As regards the Benevolent Branch it was decided that, in all cases assistance should be made by grants annually, such grants being renewable as circumstance required, but being always reviewed by each General Annual Meeting. The Committee has been authorized to deal with urgent cases as they arise during the year by making small grants in advance subject to the approval of the next Annual Meeting; and also with the administration of the Relief Branch.

The first Annual General Meeting was held on October 26, and grants made from the Benevolent Branch as follows:—

Three orphans of an officer with temporary commission	..	..	£30	0	0
Two " " " " " "	..	..	20	0	0
Two " " " " " "	..	..	40	0	0
Two " " " " " "	..	..	15	0	0
Four orphans of an officer, R.A.M.C. Territorial Forces	..	..	30	0	0
Two " " " " " "	..	..	25	0	0

Cases which have been reported since the meeting have been dealt with by the Committee under the powers delegated to them, and no doubt others will arise as the existence and objects of the funds become better known.

Sir Alfred Keogh has continued to take a great interest in the Fund, and in September last addressed a personal letter to all directors of medical services at home and abroad inviting their co-operation. As a result the number of annual subscribers has greatly increased, the total at present exceeding 1,200, and a considerable amount of money has been invested in War Loan and National War Bonds to make provision for future calls.

The success and future development of the charity may, therefore, now be considered to be assured provided that the corresponding annual subscriptions are continued, which there is no reason to doubt.

In the earlier days there seems to have been some misunderstanding as to the objects of the Funds and some officers appeared to think that they were in some way undertaking duties which should be met from public sources. Perhaps it may not be out of place to repeat that grants from these Funds in no way take the place of any pension, compassionate allowance, or gratuities to which the families of deceased officers or non-commissioned officers and men may be entitled under the Royal Warrant for Pay, &c.

The Funds are a charity pure and simple, and registered under the War Charities Act, 1916, and grants are made solely in aid of orphans (and widows and orphans in the Relief Branch), and are allotted according to the circumstances of each individual case after taking into consideration the total income of the applicants, including any pension, &c., of which they may be in receipt.

Colonel W. Hale White, R.A.M.C.(T.), has kindly undertaken the duties of Hon. Secretary and the office will shortly be moved to No. 11, Chandos Street, Cavendish Square, S.W. 1.

All communications after 31st inst. should be sent to that address.

At a Meeting of the Committee of the above Funds held January 25, the following two cases were considered:—

Widow of a Captain in the Auxiliary Royal Army Medical Corps, who died in France after two years' service. Applicant is training for a nurse in a maternity hospital. Granted £10 at once and another £10 in March.

Widow of a private in the Royal Army Medical Corps, who was drowned while on Active Service. Left with two children ages 2 and 4. Only income Army Pension. Voted £5.

Major Ewen Maclean was reappointed Chairman of the Committee, and Colonel Hale White and Colonel Mansell Moullin commenced their duties as Hon. Secretary and Hon. Treasurer. The Committee are anxious to receive applications for the relief of the orphans of commissioned officers in the Auxiliary Royal Army Medical Corps, also for the widows and orphans of non-commissioned officers and men in the same service.

Donations and subscriptions will be gratefully received and should be addressed to the Hon. Treasurer, at 11, Chandos Street, Cavendish Square, W.1, and all other communications addressed to the Hon. Secretary at the same address.

OBITUARY.

CAPTAIN HAROLD GIBSON, D.S.O.

Captain (acting Lieut.-Col.) Harold Gibson, D.S.O., who died of wounds in France on October 17, 1917, was the younger son of Surgeon Lieut.-Col. G. J. Gibson, A.M.S. (retired), of Totnes, Devon. He was born in India on September 21, 1884, and became a student at the London Hospital in 1902, taking the M.R.C.S. Eng. and L.R.C.P. Lond. in April, 1907. He joined the Service in the following July and was promoted Captain on January 29, 1911. After serving at Devonport, Portsmouth, and other places, he proceeded to India in February, 1910, where he was stationed at Poona, Jhansi and Kamptee. At this latter station (the place of his birth) he was in charge of the Cantonment Hospital, having passed the lower standard in Hindustani in July, 1911, and here he did much good work among the natives, especially during the plague season. In December, 1914, he was sent up to the North-West Frontier to take part in the operations against the Mahsuds and other hill tribes, and was given the command of a stationary hospital on the lines of communication, moving between Bannu, Pindi and Peshawar, and various outposts. But before the end of this campaign he received orders to return to England, being now tour-expired, and sailed for home on August 15, 1915.

He went to France in charge of an M.A.C., receiving the temporary rank of Major, and later was promoted an acting Lieut.-Col., with the command of a Field Ambulance, of which he was O.C. at the time of his death.

On two occasions he acted as A.D.M.S. of his Division, and was mentioned in Sir Douglas Haig's dispatch of November 7, and was awarded the D.S.O. in the *London Gazette* of January 1, 1918.

Lieut.-Col. Gibson was a good all-round athlete, besides being a most efficient officer. Many will remember him for his energy and untiring devotion to duty upon all occasions.

He married, in 1910, Maude, the eldest daughter of Dr. Kenneth Smith, of 16, Kew Gardens Road, and leaves a daughter and one son.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF
OCTOBER, NOVEMBER AND DECEMBER, 1917.

Title of Work and Author	Edition	Date	How obtained
Notes on Military Orthopædics. By Col. Sir Robert Jones, C.B.		1917	Library Grant.
Glycosuria and Allied Conditions. By P. J. Cammidge, M.D.		1913	" "
The Elements of Hygiene and Public Health. By Charles Porter, M.D.		1917	" "
A Treatise on Fractures. By Roberts and Kelly		1916	" "
Malingering, or the Simulation of Disease. By Jones and Llewellyn		1917	" "
Hygiene and Public Health. By Parkes and Kenwood ..	6th	1917	" "
Surgical Therapeutics and Operative Technique. English Edition. Vol. i. By Doyné and Spencer-Browne		1917	" "
Infected Wounds. By Carrel and Debelly		1917	" "
An Epitome of Mental Disorders. By Capt. E. F. Ballard, R.A.M.C.(T.).		1917	" "
Pathology, General and Special. By R. T. Hewlett, M.D.	4th	1917	" "
Materia Medica, Pharmacy, Pharmacology and Therapeutics. By W. Hale White, M.D.	15th	1916	" "
Massage, its Principles and Practice. By James B. Mennell, M.A., M.D.		1917	" "
The Examination of Water and Water Supplies. By John C. Thresh, D.Sc.	2nd	1913	" "
Three Lectures on the Treatment of Diabetes Mellitus by Alimentary Rest (The "Allen" Treatment). By O. Leyton, M.D.		1917	" "
A Cross-Section Anatomy. By Eycleshymer and Schoemaker		1911	" "
A Text-Book of Histology. By Jordan and Ferguson ..		1917	" "
Ligations and Amputations. By A. Broca. Translated by E. Ward, M.A., M.D.			" "
Kala-Azar and its Treatment. By U. N. Brahmachari, M.D.		1917	" "
Diseases of the Eye. By George E. de Schweintz ..	8th	1916	" "
The Medical Annual		1917	" "
Dictionary of Quotations (Classical). By T. B. Harbottle		1906	" "
Dictionary of Contemporary Quotations (English). By Helena Swan		1904	" "
Dictionary of Quotations. What Great Men have said about Great Men. By William Wale		1902	" "
Besieged in Kut—and After. By Major Charles H. Barber, I.M.S.		1917	" "
Wounded and a Prisoner of War. By an Exchanged Officer		1916	" "
Report of the Accra Laboratory for the year 1916. By J. W. Scott MacFie, D.Sc., M.A., M.B.		1917	Crown Agents for the Colonies.
Blindness in India (Pamphlet). By C. G. Henderson, Indian Civil Service		1917	Presented by the Author.
Treatment of Joint and Muscle Injuries. By W. Rowley Bristow, M.B., F.R.C.S.		1917	Presented by Surg.-Gen. M. W. Russell, C.B., A.M.S.
Comptes-Rendus de la Conférence Chirurgicale Interalliée pour l'Étude des Plaies de Guerre. (Two Copies.)		1917	War Office.
Brun's Kriegschirurgische. Band 103, Hefte 1 to 5. Band 105, Hefte 4 and 5. Band 106, Hefte 1 to 5. Band 107, Hefte 1 and 3		1916-17	" "

PRESENTATION OF MOTOR BACTERIOLOGICAL LABORATORY TO THE WAR OFFICE.

The ever-growing employment of bacteriological methods in medical and surgical treatment calls for increased facilities for the application of bacteriological technique in connexion with the sick and wounded in the present war. The necessity of providing some means of applying bacteriological tests in emergency conditions has led Mr. Henry S. Wellcome, the founder of the Wellcome Bureau of Scientific Research and of several other scientific research institutions, to present to the War Office for the use of the British Army Medical Department a completely equipped motor bacteriological laboratory.

The formal presentation of the laboratory to the War Office has just taken place. There were present Brigadier-General Sir H. C. L. Holden, K.C.B., F.R.S., from the Ministry of Munitions, also Lieutenant-Colonel G. B. Stanistreet, C.M.G., Assistant Director-General, A.M.S., and Major Smallman, representing the War Office. Deputy Surgeon-General D. J. P. McNab of the Admiralty, Surgeon-General Sir M. W. H. Russell, K.C.M.G., A.M.S., of the War Office, and Sir Frederick Treves, Bart., G.C.V.O., wrote referring in appreciative terms to this handsome and useful gift.

In making the presentation, Mr. George E. Pearson, addressing Colonel Stanistreet, said:—

"I regret that Mr. Wellcome is unable to be here and personally make this presentation. Unfortunately he is obliged to remain abroad because his medical advisors will not permit him to return for the present.

"On his behalf I have much pleasure in asking you, sir, as the representative of the War Office, to accept this motor bacteriological laboratory for the use of the Army Medical Department abroad, where I trust its varied scientific equipment may be found of special service in dealing with medical problems on the spot.

"The body of the car and its extended weatherproof annexe form a self-contained laboratory affording a total working space of 219 square feet. A complete bacteriological equipment is supplied in thirteen strongly made canteens so arranged that the contents are easily accessible, but securely safeguarded against damage in transit from place to place under rough and difficult conditions of transport.

"The equipment is completed by the addition of the necessary tables, incubators, microscopes, balances, autoclave, centrifuge, etc., and a water tank fitted with a suitable pump is erected on the roof of the car.

"The annexe and the bacteriological fittings, etc., are so designed that they can be readily assembled and securely packed on the accompanying three-ton chassis.

"I desire gratefully to acknowledge the courtesy of the London Committee of the French Red Cross Society and of Dr. Tilmant and Professor Garstang in permitting the use of their plans and specifications."

Colonel Stanistreet then suitably expressed on behalf of the War Office his high appreciation of the most appropriate gift, which he was confident would be of considerable value to the Army.

The company then proceeded to inspect the equipment which, in addition to the apparatus mentioned above, includes hot chambers, Pasteur oven, microtome, ice chest for water test samples, a complete electric lighting outfit including a dynamo and accumulators, and a provision for animal cages on the roof. Even the apparatus for the staff-mess, and sleeping accommodation is included. The arrangements for the many thousands of accessories and for their safe storage and transport in the drawers of the canteen have been worked out with extraordinary ingenuity, so that everything is conveniently grouped and readily accessible.

The outfit, which is complete in every detail, is self-contained, and owing to the method of construction can be either assembled or packed for transport in about two hours.

BIRTH.

McGRIGOR.—On October 4, 1917, at Ootacamund, S. India, the wife of Captain D. Buchanan McGrigor, R.A.M.C., of a son.

MARRIAGES.

FRASER—OGDEN.—At St. Paul's, Blackpool, on December 22, 1917, Major A. N. Fraser, D.S.O., R.A.M.C., son of Dr. A. Duncan Fraser, of Falkirk, to Constance, elder daughter of Herman Ogden, of Buxton.

MARTIN—McLAUGHLIN.—On December 28, 1917, at St. Marylebone Church, Major Arthur J. Martin, R.A.M.C.(T.), 2nd London Sanitary Company, to Ownye Salwey McLaughlin, eldest daughter of the Rev. A. H. McLaughlin, of Overdale, Malvern.

DEATH.

GIBSON.—Died of wounds in France, on October 17, 1917, Capt. (acting Lieut.-Col.) Harold Gibson, D.S.O., R.A.M.C., younger son of Surgeon Lieut.-Col. G. J. Gibson, A.M.S. (retired), of Totnes, Devon, and dearly-loved husband of Maude Gibson, aged 33.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

NUMBER OF REPRINTS	NUMBER OF PAGES	COST OF REPRINTS	COST OF EXCERPTS*	EXTRA FOR COVERS FOR REPRINTS			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
12	4	£ s. d. 0 2 9	£ s. d. 0 1 2	4 3	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. net; binding, 2s.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C.

The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 824, Adastral House, Victoria Embankment, E.C. 4.

The following publications have been received:—

British: The Army Service Corps Journal, The Hospital, Memoirs of the Department of Agriculture in India, Agricultural Research Institute, Pusa, The Indian Medical Gazette, Guy's Hospital Gazette, The British Journal of Tuberculosis, The Medical Review, Public Health, The British Journal of Surgery, The Medical Press and Circular, Proceedings of the Royal Society of Medicine, Edinburgh Medical Journal, The Journal of Tropical Medicine and Hygiene, The Journal of State Medicine, St. Bartholomew's Hospital Journal, The Saturday Review, The Medical Journal of South Africa, Journal of the Royal Naval Medical Service, Tropical Veterinary Bulletin, Transactions of the Society of Tropical Medicine and Hygiene.

Foreign: La Caducée, Bulletin de la Société de Pathologie exotique, Archives de Médecine et Pharmacie Navales, Bulletin of the Johns Hopkins Hospital, The Journal of Infectious Diseases, Bulletin de l'Institut Pasteur, Giornale di Medicina Militaire, Norsk Tidsskrift for Militær-medicin, L'Ospedale Maggiore.

MANAGER'S NOTICES.

The **JOURNAL OF THE ROYAL ARMY MEDICAL CORPS** is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As however, the particulars of this list are supplied from official sources, Officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,

"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"

25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C.4.

JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.

Corps News.

FEBRUARY, 1918.

EXTRACTS FROM THE LONDON GAZETTE.

War Office,
January 14, 1918.

The following Russian Decorations and Medals have been awarded at various dates for Distinguished Services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

ORDER OF ST. ANNE, 2ND CLASS (WITH SWORDS).

Lieut.-Col. (Acting Col.) Henry Hewetson, D.S.O., Royal Army Medical Corps.

ORDER OF ST. ANNE, 3RD CLASS.

Temp. Capt. Arthur Herbert Spicer, M.B., Royal Army Medical Corps.

ORDER OF ST. STANISLAS, 2ND CLASS.

Lieut.-Col. Wilfred William Ogilvy Beveridge, C.B., D.S.O., M.B., Royal Army Medical Corps.
Temp. Major Lanyon Edward Owen, Royal Army Medical Corps.

ORDER OF ST. STANISLAS, 3RD CLASS (WITH SWORDS).

Lieut. (Temp. Capt.) Thomas James Kelly, M.C., M.B., Royal Army Medical Corps.

ORDER OF ST. STANISLAS, 1ST CLASS.

Surg.-Gen. John Dallas Edge, C.B., M.D., F.R.C.S.

ORDER OF ST. STANISLAS, 3RD CLASS (WITH SWORDS).

Hon. Capt. John Herbert Diamond, Canadian Army Medical Corps.
Capt. Charles Allen Yates, Canadian Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-Commissioned Officers and Men :—

No. 341509 (formerly No. 1916) Serjt. B. Jones, Royal Army Medical Corps (Wrexham).
(M.M. gazetted July 9, 1917.)

No. 339198 (formerly No. 1563) Serjt. S. J. Kay, Royal Army Medical Corps (Liverpool).
(M.M. gazetted July 18, 1917.)

No. 341364 (formerly No. 1754), Serjt. A. Stephenson, Royal Army Medical Corps (Wigan).
(M.M. gazetted August 16, 1917.)

No. 341628 (formerly No. 2053) Pte. P. Harrison, Royal Army Medical Corps (St. Helens).
(M.M. gazetted November 2, 1917.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-Commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 90800 Pte. F. C. Alder (Birmingham).
No. 301452 Pte. C. S. Auld (Mersat).
No. 341025 Pte. G. Barron (Thatto Heath).
No. 60326 Pte. F. Beasley (Birmingham).
No. 339463 Pte. J. H. Binedell (Capetown).
No. 339377 Pte. W. M. Bishop (Liverpool).

No. 50308 Pte. R. Slyth (Dundee).
No. 50290 Pte. R. A. Bouckley (Birmingham).
No. 352126 Pte. E. Brownwood (Burnley).
No. 49980 Pte. G. A. Burnage (Stanley).
No. 497601 Lance-Cpl. (Acting Cpl.) S. A. Callaway (Slough).

No. 41517 Pte. D. Challenor (Achddw).
 No. 36309 Pte. (Acting Lance-Cpl.) J. Clarke (Lochgelly).
 No. 106906 Pte. E. D. Collins (Middlesbrough).
 No. 72169 Pte. W. C. Daniels (Chelmsford).
 No. 65867 Pte. H. Everall (Malvern Link).
 No. 50296 Staff-Serjt. H. Fisher (Abbots Langley).
 No. 354246 Serjt. A. H. Fox (Stockport).
 No. 69659 Pte. T. H. Francis (Greenwich).
 No. 36505 Serjt. J. V. Green (Handsworth).
 No. 72773 Pte. O. Hariwell (Harroden).
 No. 77444 Pte. F. Hodgson (York).
 No. 72003 Pte. F. Hodson (Burton Latimer).
 No. 47018 Pte. N. Hough (Alderney).
 No. 341318 Serjt. T. R. Jackson (St. Helens).
 No. 301352 Cpl. A. Livingstone (Dundee).
 No. 354337 Serjt. J. Lomax (Eccles).
 No. 341178 Cpl. J. McDermott (St. Helens).

No. 93945 Serjt. P. J. Mitchelson (Glasgow).
 No. 303297 Pte. A. Morrison (Aberdeen).
 No. 12298 Pte. S. G. Phillips (Kingswinford).
 No. 352205 Pte. (Acting Lance-Cpl.) H. D. Preston (Burnley).
 No. 30997 Serjt. P. T. Read (Bournemouth).
 No. 368097 Pte. P. I. Rees (Garnant).
 No. 341576 Lance-Cpl. T. Sherlock (Blackpool).
 No. 473007 Serjt. A. G. Shrubbs (Ipawich).
 No. 47207 Cpl. (Acting Serjt.) G. Sim (Bridge of Allan).
 No. 341771 Pte. T. Singleton (Carlisle).
 No. 53779 Pte. J. Stephen (Mill of Auchintoul).
 No. 337597 Pte. E. R. Stuckey (Cardiff).
 No. 337634 Pte. S. W. Stuckey (Cardiff).
 No. 337211 Serjt. J. Tickle (Formby).
 No. 33334 Pte. A. Turner (Bristol).
 No. 475351 Pte. R. H. Watson (Cambridge).

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officers and Men in recognition of valuable services rendered in the performance of Military duty :—

No. 18604 Staff Serjt. W. Tindall, Royal Army Medical Corps (Bradford).
 No. 2091 Pte. (Acting Cpl.) T. W. Elwood, Royal Army Medical Corps (Sheffield).
 No. 178 Serjt. A. E. Wilkinson, Royal Army Medical Corps (Caterham).

War Office,
 January 28, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for Distinguished Services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS CONFERRED BY H.M. THE KING OF SERBIA.

Order of St. Sava, 2nd Class.

Surgeon-General Sir Hayward Reader Whitehead, K.C.B., Director of Medical Services, British Salonika Force.

Order of St. Sava, 3rd Class.

Lieut.-Col. Francis John Brakenridge, C.M.G., Royal Army Medical Corps.
 Lieut.-Col. Herbert John Martin Buist, D.S.O., M.B., Royal Army Medical Corps.
 Col. Stephen Frazer Clark, M.B., late Royal Army Medical Corps.
 Temp. Col. Thomas Crisp English, C.M.G., M.B., F.R.C.S., Army Medical Service.
 Lieut.-Col. Bernard Forde, C.M.G., M.B., Royal Army Medical Corps.
 Lieut.-Col. Archibald Gilchrist Hay, M.D., Royal Army Medical Corps.
 Temp. Col. James Purves Stewart, C.B., M.D., F.R.C.P., Army Medical Service.
 Col. Alexander Arthur Sutton, C.B., D.S.O., Royal Army Medical Corps.

Order of St. Sava, 4th Class.

Capt. Alfred Edward Barnes, M.B., Royal Army Medical Corps.
 Capt. Edward John Yelverton Brash, Royal Army Medical Corps.
 Brevet Major Daniel Maurice Corbett, M.B., Royal Army Medical Corps.
 Capt. Harold William Farebrother, Royal Army Medical Corps.
 Temp. Capt. Richard Desmond Fitzgerald, M.B., Royal Army Medical Corps.
 Temp. Capt. Charles York Flewitt, M.B., Royal Army Medical Corps.
 Capt. William Rickards Galwey, M.C., M.B., Royal Army Medical Corps.
 Temp. Capt. Arthur Atkins Greenwood, M.B., Royal Army Medical Corps.
 Capt. Archibald Wilson Harrington, M.D., Royal Army Medical Corps.
 Temp. Capt. Walter Haward, M.B., Royal Army Medical Corps.
 Major John Tyrer Johnson, D.S.O., M.D., Royal Army Medical Corps.
 Temp. Major James Benjamin Melville, Army Medical Service.
 Temp. Major George Percival Mills, M.B., Royal Army Medical Corps.
 Temp. Major Keith Waldegrave Monsarratt, M.B., F.R.C.S., Royal Army Medical Corps.
 Capt. William Lombard Murphy, Royal Army Medical Corps.
 Temp. Major Leonard Gregory Parsons, Royal Army Medical Corps.
 Major Henry Rutherford, M.D., Royal Army Medical Corps.

Capt. Richard Vincent Slattery, Royal Army Medical Corps.
 Temp. Capt. Clare Oswald Stallybrass, Royal Army Medical Corps.
 Major Frederick Archer Stephens, D.S.O., Royal Army Medical Corps.
 Major Walter John Weston, D.S.O., Royal Army Medical Corps.
 Harold Waterlow Wiltshire, Esq., M.D., Royal Army Medical Corps.
 Temp. Capt. Lionel Dudley Woods, Royal Army Medical Corps.

Order of St. Sava, 5th Class.

Temp. Qmr. and Hon. Lieut. Hubert James Angell, Royal Army Medical Corps.
 Temp. Qmr. and Hon. Lieut. John Fraser, Royal Army Medical Corps.
 Temp. Lieut. John Norman McTurk, M.D., Royal Army Medical Corps.
 Temp. Qmr. and Hon. Lieut. Frederick William Sharpe, Royal Army Medical Corps.
 Temp. Qmr. and Hon. Major Harry Humphreys Taylor, M.B., Royal Army Medical Corps.
 Temp. Lieut. Harold Cairns Terry, Royal Army Medical Corps.
 Temp. Lieut. John Henry Watson, Royal Army Medical Corps.

Order of St. Sava, 3rd Class.

Major (Temp. Lieut.-Col.) Alexander Edward Kidd, M.B., Royal Army Medical Corps.

Order of St. Sava, 4th Class.

Temp. Capt. Frederick Michael Bishop, Royal Army Medical Corps.
 Capt. Bernard Langridge Davis, Royal Army Medical Corps.
 Capt. James Fenton, M.D., Royal Army Medical Corps.
 Capt. Robert Fullarton, M.B., Royal Army Medical Corps.
 Temp. Lieut. Bernard Whitchurch Howell, M.B., F.R.C.S., Royal Army Medical Corps.
 Capt. Alexander Brown Jamieson, M.B., Royal Army Medical Corps.
 Capt. Philip Henry Mitchiner, M.B., F.R.C.S., Royal Army Medical Corps.
 Capt. Alexander Reid Moodie, M.B., Royal Army Medical Corps.
 Capt. William Arthur Valentine, M.D., Royal Army Medical Corps.
 Major Hugh Walker, M.B., Royal Army Medical Corps.

Order of St. Sava, 5th Class.

Captain Harry James Shields, Canadian Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 3877 Pte. W. Bonner (Londonderry).	No. 4700 Cpl. (Acting Serjt.) F. Gardner (W. Kensington).
No. 403111 Pte. R. Bottomley (Leeds).	No. 461944 Cpl. C. R. Garrett (Eastleigh).
No. 65289 Pte. S. F. Bourne (Canterbury).	No. 65900 Pte. C. E. Golden (Homefield).
No. 77190 Pte. C. Bouttall (Hackney).	No. 5862 Cpl. (Acting Serjt.) G. T. Gwilt (Wolverhampton).
No. 405247 Cpl. H. Bower (Sheffield).	No. 10368 Pte. A. Halliwell (Ince).
No. 8691 Pte. F. H. Boyer (Newton Abbot).	No. 9263 Pte. F. Hawley (Derby).
No. 62485 Pte. W. Boys (Liverpool).	No. 46783 Pte. E. Haynes (Hunsley).
No. 106232 Pte. A. A. Brawn (Wellingborough).	No. 277 Pte. H. H. Haynes (Godalming).
No. 36765 Cpl. (Acting Serjt.) S. Bristow (Atherstone).	No. 3981 Pte. T. Henderson (Dundee).
No. 8252 Pte. A. Buckley (Shaw).	No. 34989 Serjt. H. E. Hogg (Croydon).
No. 58336 Pte. (Acting Lance-Cpl.) J. Burbidge (Doncaster).	No. 5800 Pte. (Acting Lance-Cpl.) F. J. Hollier (Bristol).
No. 32055 Pte. C. Burton (West Hartlepool).	No. 37483 Pte. H. C. M. Hooper (Darlington).
No. 78402 Pte. H. Burton (Hunslet).	No. 667 Pte. G. Jarvis (Worcester).
No. 437253 Pte. W. Church (Birmingham).	No. 77644 Pte. W. S. Jenkins (Brixton).
No. 439199 Pte. F. G. Clark (Bristol).	No. 5810 Pte. V. Keily (Stradbally).
No. 31164 Pte. W. Cliff (Barnsley).	No. 439131 Cpl. F. G. Lodge (Bristol).
No. 80759 Pte. M. F. Cooper (Ramsgate).	No. 1108 Pte. J. Marner (Dunadry).
No. 403564 Lance-Cpl. R. J. Cooper (Leeds).	No. 93439 Pte. W. F. Marshall (Bradford).
No. 33115 Cpl. R. Christie (Glasgow).	No. 47673 Pte. A. W. Martin (Bosham).
No. 4709 Pte. R. J. E. Crosland (Todmorden).	No. 9258 Pte. C. A. Martin (Derby).
No. 45038 Pte. H. Doherty (Bolton).	No. 457155 Cpl. T. H. Matthews (Exeter).
No. 3108 Pte. J. Donnelly (Arklow).	No. 3135 Pte. (Acting Serjt.) H. McDonald (Glasgow).
No. 29253 Pte. F. Entwistle (Oswaldtwistle).	No. 43044 Pte. R. McLean (Lochgelly).
No. 437062 Pte. S. Fearn (Birmingham).	No. 7720 Pte. W. McQueen (Edinburgh).
No. 87520 Pte. C. F. Field (Horsham).	No. 69252 Pte. W. G. Millington (Shrewsbury).
No. 72622 Pte. H. S. Foster (Wood Green).	No. 88173 Pte. G. D. Morrison (Aberdeen).
No. 78732 Pte. W. L. Francis (Woodford).	No. 61185 Pte. A. Mountford (Bashford).
No. 70942 Pte. F. Frank (Hull).	No. 19675 Serjt. C. Newland (Wrexham).
No. 459302 Lance-Cpl. H. A. French (Ashburton).	

No. 65756 Pte. A. E. Payne (Dover).
 No. 92216 Pte. A. C. Pook (Plymouth).
 No. 437359 Lance-Cpl. C. Pratt (Birmingham).
 No. 54483 Serjt. W. Price (Brookend).
 No. 435169 Pte. W. Raybould (Aston).
 No. 36040 Pte. (Acting Cpl.) C. J. Rogers
 (Abbots Langley).
 No. 92464 Pte. J. G. Sandbrook (Stockton-on-
 Tees).
 No. 57998 Pte. D. Scutt (Portslade).
 No. 74579 Pte. G. W. Seal (Berkhamsted).
 No. 5736 Pte. (Acting Cpl.) C. Seby (Wal-
 worth).
 No. 58419 Pte. J. Sergeant (Blackpool).
 No. 435443 Pte. G. Shakeshaft (Wellington).
 No. 89132 Pte. S. Shepherd (Dunstan-on-Tyne).

No. 54711 Pte. (Acting Lance-Cpl.) S. Sloan
 (Hamolton).
 No. 19815 Corpl. (Acting Serjt.) A. Smith
 (Harwich).
 No. 33354 Pte. A. E. Smith (Halifax).
 No. 9035 Pte. H. Stallard (Port Sunlight).
 No. 74593 Pte. S. J. Staniford (Berkhamstead).
 No. 45798 Pte. J. G. Stormont (Sunderland).
 No. 3524 Pte. (Acting Lance-Corpl.) R. A.
 Swales (York).
 No. 53089 Pte. D. Thomson (Dundee).
 No. 403550 Lance-Corpl. H. H. Turner (Morley).
 No. 33591 Pte. C. Viney (Stanford).
 No. 20458 Pte. R. Ward (Dereham).
 No. 403067 Serjt. E. Wilkinson (New Wortley).
 No. 7079 Pte. (Acting Serjt.) J. F. Williams
 (Newton Abbot).

War Office,

February 4, 1918.

His Majesty the King has been pleased to confer the undermentioned rewards for Gallantry and Distinguished Service in the Field. The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as possible:—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Major (Temp. Lieut.-Col.) Arthur Carr Osburn, D.S.O., Royal Army Medical Corps (D.S.O. gazetted June 3, 1916).

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. Ferguson Fitton Carr-Harris, M.D., Royal Army Medical Corps.

Major (Temp. Lieut.-Col.) Charles Arthur Algernon Stidson, M.D., Royal Army Medical Corps.

AWARDED A BAR TO THE MILITARY CROSS.

Capt. Cuthbert Delaval Shafto Agassiz, M.C., M.D., Royal Army Medical Corps.

Temp. Capt. Arthur Joseph Blake, M.C., Royal Army Medical Corps (M.C. gazetted September 22, 1916).

Capt. Eric Alfred Charles Fazan, M.C., Royal Army Medical Corps (M.C. gazetted January 14, 1916).

Temp. Capt. James Wallace Macfarlane, M.C., M.D., Royal Army Medical Corps.

Capt. Samuel McCausland, M.C., Royal Army Medical Corps (M.C. gazetted July 26, 1917).

Capt. Joseph Stephen Wallace, M.C., Royal Army Medical Corps (M.C. gazetted July 26, 1917).

AWARDED THE MILITARY CROSS.

Royal Army Medical Corps.

Capt. Robert Vacy Clifford Ash.

Capt. Arthur Joseph Beveridge, M.B., Special Reserve.

Capt. John Holiday Blackburn, M.B.

Temp. Capt. Joseph Victor Cope, M.B.

Temp. Capt. David McMurray Dickson.

Capt. (Temp. Major) John Douglas Fiddes.

Capt. John Henry Pearson Fraser, M.B.

Capt. Philip Jacob Gaffin, M.B., Special Reserve.

Temp. Capt. Hugh Bernard German.

Temp. Capt. Frank Arthur Grange, M.B.

Temp. Capt. Edwin Allan Thomas Green.

Temp. Lieut. Arthur Collis Hallows, M.B.

Temp. Capt. James Phillips Jones.

Temp. Capt. Frederick Bennett Julian, M.B.

Temp. Capt. Arthur Griffiths Maitland-Jones.

Lieut. (Temp. Capt.) William Wyllie Mac-
 Naught, M.B.

Temp. Capt. James Manuel, M.B.

Lieut. John Marshall, M.B., Special Reserve.

Temp. Capt. Duncan John McAfee, M.D.

Temp. Capt. Frederick Buick McCarter, M.B.

Temp. Capt. James Allen Montgomery, M.D.

Capt. George Morris, M.B., Special Reserve.

Temp. Lieut. David Assur Henry Moses.

Temp. Lieut. Evan Edward Owens.

Capt. Harold Dobson Pickles, M.B.

Capt. John Alexander Pridham, Special Reserve.

Capt. William Robertson, M.B.

Temp. Capt. Lionel Matthew Rowlette, D.S.O.

Temp. Capt. Cedric Russell, M.B.

Temp. Capt. Robert Rutherford, M.B.

Temp. Capt. Brian Herbert Swift, M.B.

Capt. Arthur Peregrine Thomson.

Temp. Capt. George Dibbs King Waldron, M.B.

Capt. Douglas Larmer Wall, M.B.

Capt. James Anderson Young, M.D., Special Reserve.

Capt. James Carruthers Young, M.D., Special Reserve.

No. 32610 S. M. Frank Hulbert.

Lieut. S. Dutt, Indian Medical Service.

Canadian Force.
Army Medical Corps.

Capt. Edgar Douglas.
Capt. Austin Dwight Irvine.
Capt. Gordon Leigh Jepson.

Capt. James Grant MacNeill.
Capt. Wesley Herbert Secord.
Capt. William Ewing Sinclair.

New Zealand Force.

Capt. Rex Carrington Brewster, F.R.C.S., Medical Corps.

His Majesty the King has been graciously pleased to approve the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers and Men:—

No. 386062 Serjt. J. Malia, Royal Army Medical Corps (Newcastle-on-Tyne) (M.M. gazetted October 27, 1916).

No. 19306 Corpl. (Acting Serjt.) C. Speller, Royal Army Medical Corps (Nutana, Canada).

No. 1485 Pte. J. Tipping, Royal Army Medical Corps (Belfast) (M.M. gazetted March 12, 1917).

No. 1407 Cpl. (Acting Serjt.) G. Staples, Royal Army Medical Corps (Tulse Hill) (M.M. gazetted July 9, 1917).

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

ROYAL ARMY MEDICAL CORPS.

No. 54771 Pte. (Acting Serjt.) J. Anderson (Hirst Ashington).	No. 493441 Serjt. R. N. Marchant (Sevenoaks).
No. 59053 Pte. W. Armstrong (Norwich).	No. 68092 Pte. H. McCann (Smithone Croy, by Glasgow).
No. 495466 Pte. W. J. Bailey (Easton).	No. 51934 Pte. M. Meehan (Ferryhill).
No. 497272 Lance-Cpl. C. F. Bicknell (Tolworth, Surrey).	No. 43277 Pte. W. Mellor (Oldham).
No. 497518 Pte. W. J. Brickwood (Horsham).	No. 305315 Pte. D. M. Meston (Roslyn, Midlothian).
No. 63901 Pte. B. G. Brown (Lower Edmonton).	No. 495412 Serjt. W. A. Nowers (Canterbury).
No. 18814 Pte. R. Butcher (Crawley).	No. 350191 Lance-Serjt. E. E. Parry (Chorlton-on-Medlock).
No. 63856 Pte. J. Carroll (Old Cummock).	No. 32959 Pte. R. Plumridge (High Wycombe).
No. 459473 Serjt. H. S. Cliff (Torquay).	No. 63643 Pte. T. S. Purcell (New York).
No. 51587 Pte. W. Collier (Bolton).	No. 73610 Pte. H. E. Rushton (Ashbourne).
No. 35664 Cpl. (Acting Serjt.) R. Davies (Putson).	No. 493628 Pte. H. J. Sanders (Kettaring).
No. 341734 Pte. G. Farrimond (St. Helens).	No. 318411 Pte. W. Scott (Selkirk).
No. 1418 Pte. G. J. Gentry (Tooting, S.W.).	No. 417343 Pte. W. Shannon (Derby).
No. 68193 Cpl. T. Geraghty (Dublin).	No. 5289 Pte. F. Sims (East Huddersfield).
No. 105765 N. W. Green (Littleton, Yorks).	No. 40609 Pte. H. Spence (Oldham).
No. 90561 Pte. H. B. Griffiths (Shrewsbury).	No. 78828 Pte. H. C. Stables (Halifax).
No. 4976 Cpl. W. W. C. Hall (Liverpool).	No. 69931 Pte. T. Stafford (Newcastle-on-Tyne).
No. 5064 Pte. (Acting Lance-Cpl.) T. Horrocks (Liverpool).	No. 90053 Cpl. F. J. Stevens (Margate).
No. 497593 Pte. E. Howe (Richmond).	No. 63872 Pte. (Acting Lance-Cpl.) T. Taaffe (Louth, co. Louth).
No. 534233 Serjt. H. Hubbard (West Croydon).	No. 386046 Pte. J. Tearce (Newcastle-on-Tyne).
No. 48795 Pte. A. L. Jones (Ferndale).	No. 497309 Serjt. A. A. Weaver (Kew Gardens).
No. 495980 Serjt. A. Kimberley (Slough).	No. 30399 Pte. G. Wilmot (Cullompton).
No. 493620 Pte. W. C. Madley (Barnsbury, N.).	No. 74694 Pte. F. A. Wyllyams (Bristol).

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
February 7, 1918.

The King has been graciously please to give directions for the following appointments to the Most Distinguished Order of Saint Michael and Saint George for services rendered in connexion with Military Operations in Mesopotamia. To be dated January 1, 1918.

To be Additional Members of the Third Class or Companions of the said Most Distinguished Order:—

Col. (Temp. Surg.-Gen.) Alfred Percy Blenkinsop, C.B., Army Medical Service.

War Office,
February 7, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for Distinguished Services rendered in connexion with Military Operations in Mesopotamia, dated January 1, 1918.

TO BE BREVET LIEUTENANT-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Major (Temp. Lieut.-Col.) W. H. Hamilton, D.S.O., F.R.C.S., Indian Medical Service.
 Major (Acting Lieut.-Col.) J. C. H. Leicester, M.D., F.R.C.S., Indian Medical Service.
 Major W. H. Leonard, F.R.C.S., Indian Medical Service.

TO BE BREVET MAJOR.

(On Retired List, Reserve of Officers, Special Reserve, New Army or Territorial Force, in the case of Officers belonging to these categories, as applicable.)

Capt. G. G. James, M.B., Indian Medical Service.
 Capt. J. A. S. Phillips, Indian Medical Service.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Major (Temp. Lieut.-Col.) Robert Macpherson Barron, Indian Medical Service.
 Major (Temp. Lieut.-Col.) Frank Powell Connor, F.R.C.S., Indian Medical Service.
 Major (Acting Lieut.-Col.) Charles Aikman Gourlay, M.D., Indian Medical Service.
 Lieut.-Col. Thomas Bernard Kelly, F.R.C.S., Indian Medical Service.
 Major Edmund Arthur Roberts, Indian Medical Service.
 Major (Assistant Lieut.-Col.) Joseph Francis Whelan, M.D., Royal Army Medical Corps.

AWARDED THE MILITARY CROSS.

Capt. Hargobind Lal Batra, Indian Medical Service.
 Temp. Capt. Robert Campbell Bogg, M.B., Royal Army Medical Corps. —
 Capt. John Williamson Dalglish, M.B., Royal Army Medical Corps (Special Reserve).
 Capt. Monindranath Das, M.B., Indian Medical Service.
 Temp. Capt. Richard Denis Davy, M.B., Royal Army Medical Corps.
 Capt. Paul Knighton Gilroy, M.B., Indian Medical Service
 Temp. Capt. Robert Hamer Hodges, Royal Army Medical Corps.
 Lieut. William Peat Hogg, Indian Medical Service.
 Temp. Capt. William Edward Hopkins, M.B., F.R.C.S., Royal Army Medical Corps.
 Capt. John Wilson Maclean, M.B., Royal Army Medical Corps (Special Reserve).
 Temp. Capt. Robert Yelverton Stones, M.B., F.R.C.S.E., Royal Army Medical Corps.

AMENDMENTS.

The following are the correct descriptions of Officers and other ranks whose rewards were published in the *London Gazette*, dated January 1, 1918.

Page 6, Col. Rupert Major Downs, Australian Army Medical Corps. (C.M.G. awarded.)

Page 6, Col. Arthur Thomas White, Australian Army Medical Corps. (C.M.G. awarded.)

Awarded Distinguished Service Order.

Page 24, Major George Waterston Miller, Royal Army Medical Corps.
 Page 27, Major Alan Sinclair Darvell Barton, Australian Army Medical Corps.
 Page 28, Lieut.-Col. Charles Ernest Wassell, Australian Army Medical Corps.

Awarded the Military Cross.

Page 42, Qmr. and Hon. Capt. John Hannaford Maunder, Royal Army Medical Corps.
 Page 53, delete Capt. Richard Todd Wilson Herald, Canadian Army Medical Corps. The award of the Military Cross to this officer is shown on page 52.

War Office,

February 18, 1918.

His Majesty the King has been pleased to confer the undermentioned rewards for Gallantry and Distinguished Service in the Field. The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable :—

AWARDED A SECOND BAR TO MILITARY CROSS.

Temp. Capt. Archibald Fullerton, M.C., M.B., Royal Army Medical Corps (M.C. gazetted January 1, 1917, Bar to M.C. gazetted October 18, 1917).

Capt. William Fotheringham, M.C., M.D., Royal Army Medical Corps, Special Reserve (M.C. gazetted August 16, 1917).

Temp. Capt. William John Knight, M.C., M.D., Royal Army Medical Corps (M.C. gazetted May 31, 1916).

Capt. Thomas Ainsworth Townsend, M.C., Royal Army Medical Corps (M.C. gazetted November 25, 1916).

Canadian Force.

Capt. Frederick William Lees, M.C., Army Medical Corps (M.C. gazetted January 1, 1917).

AWARDED THE MILITARY CROSS.

Temp. Capt. Eric Phillip Blashki, M.B., Royal Army Medical Corps.

Capt. Frank Chadwick, M.B., Royal Army Medical Corps.

Temp. Capt. Thomas Maitland Crawford, M.B., Royal Army Medical Corps

Temp. Capt. William Cloughton Douglass, Royal Army Medical Corps.

Temp. Lieut. Frederick Barnes Elwood, Royal Army Medical Corps.
 Capt. Archibald McLaren Ferrie, M.B., Royal Army Medical Corps, Special Reserve.
 4th Class Assistant Surgeon James Garnett Goodman, I.S.M.D.
 Temp. Capt. James Huntly Legge, M.B., Royal Army Medical Corps.
 Capt. Reginald Devereux Moore, Royal Army Medical Corps.
 Capt. John Gilbert Morgan, Royal Army Medical Corps.
 Temp. Capt. John Oscar Thomas, Royal Army Medical Corps.
 Temp. Capt. Philip Hewer Wells, Royal Army Medical Corps.
 Temp. Capt. Ernest William Gilmore Young, M.B., Royal Army Medical Corps.
 Capt. Gavin Young, M.B., Royal Army Medical Corps, Special Reserve.

Canadian Force.

Capt. George May Foster, Army Medical Corps.
 Capt. Alfred Stannage Porter, Army Medical Corps.

His Majesty the King has been pleased to award the Distinguished Conduct Medal to the undermentioned for Gallantry and Distinguished Service in the Field :—
 No. 492032 Serjt. J. Easton, Royal Army Medical Corps (Margate).

For conspicuous gallantry and devotion to duty. The ambulance was shelled, and he was wounded in several places, but he remained at duty and continued to attend to the wounded under fire. He set a splendid example to all.

No. 39741 Pte. J. Gallimore, Royal Army Medical Corps (Tyldesley).

For conspicuous gallantry and devotion to duty. He showed great courage and self-sacrifice in attending to the wounded under heavy fire.

No. 362050 Qmr.-Serjt. (Acting Serjt.-Major) J. E. Pritchard, Royal Army Medical Corps (Chester).

For conspicuous gallantry and devotion to duty. He rendered valuable service in connexion with the formation of an amalgamated field ambulance, the success of which was largely due to his good work.

No. 368311 Pte. W. W. Ward, Royal Army Medical Corps (Swansea).

For conspicuous gallantry and devotion to duty. When orders were given for the advanced dressing station to withdraw, there was not sufficient transport available to remove all the casualties. He was left with six severely wounded cases, but with great initiative and skill he extemporized means for getting them away, and succeeded in removing them all to safety and preventing their capture by the enemy.

No. 851 1st Class Sub-Assistant Surgeon Bhagwan Singh, I.S.M.D., gazetted June 26, 1916

No. 1115 1st Class Sub-Assistant Surgeon Ishar Singh, I.S.M.D., gazetted June 26, 1916.

War Office,

February 12, 1918.

The undermentioned Officers have been brought to the notice of the Secretary of State for War, by the Army Council, for very valuable services rendered in connexion with the war up to December 31, 1917 :—

Lieut.-Col. H. S. Anderson, Royal Army Medical Corps.

Temp. Lieut.-Col. A. Balfour, C.M.G., M.D., F.R.C.P., Royal Army Medical Corps.

Temp. Col. C. A. Ballance, C.B., M.V.O., M.B., F.R.C.S., Army Medical Service.

Surg.-Gen. Sir D. Bruce, Knt., C.B., F.R.S., F.R.C.P., M.B. (retired pay), late Army Medical Service.

Temp. Hon. Lieut.-Col. Buchanan, G.S., M.D., Royal Army Medical Corps.

Major and Bt. Lieut.-Col. R. M. Carter, F.R.C.S., Indian Medical Service.

Col. W. Coates, C.B., V.D., Royal Army Medical Corps (T.F.), Reserve (retired).

Temp. Hon. Col. Sir J. Collic, M.D., Army Medical Service.

Temp.-Col. A. E. Garrod, C.M.G., M.D., F.R.S., Army Medical Service.

Col. Graham, M.D., C.B.

Major T. W. Griffith, M.D., Royal Army Medical Corps.

Col. J. Griffiths, M.D., F.R.C.S., T.D., Royal Army Medical Corps.

Surg.-Gen. F. J. Jencken, M.B., Army Medical Service.

Temp. Hon. Lieut.-Col. H. R. Kenwood, M.B., Royal Army Medical Corps (Major, Royal Army Medical Corps (T.F.)).

Temp. Lieut.-Col. J. C. C. Ledingham, M.B., Royal Army Medical Corps.

Col. C. H. Melville, M.B., Army Medical Service.

Col. C. P. Oliver, M.D., K.H.P., T.D., Army Medical Service.

Temp. Lieut.-Col. G. B. Price, M.D., Royal Army Medical Corps.

Temp. Hon. Lieut.-Col. J. Robertson, M.D., Royal Army Medical Corps.

Lieut.-Col. (Hon. Surg.-Col.) (Temp. Col.) W. M. Roocroft, V.D., Royal Army Medical Corps.

Col. and Hon. Surg.-Gen. M. W. Russell, C.B. (retired pay), late Army Medical Service.

Lieut.-Col. A. de C. Scanlan, Royal Army Medical Corps (retired pay) (Reserve of Officers).

Temp. Col. H. H. Tooth, C.M.G., M.D., Army Medical Service (Lieut.-Col., Royal Army Medical Corps (T.F.)).

Temp. Lieut.-Col. C. M. Wenyon, M.B., Royal Army Medical Corps.

ARMY MEDICAL SERVICE.

Col. T. H. J. C. Goodwin, C.M.G., D.S.O., to be Surgeon-General, vice Surg.-Gen. T. J. O'Donnell, C.B., D.S.O. (retired), January 11, 1918.

Surg.-Gen. T. H. J. C. Goodwin, C.M.G., D.S.O., to be Deputy Director-General, dated January 24, 1918.

Lieut.-Col. Horace S. Roch, D.S.O., to be Temp. Col. whilst employed as Assistant Director of Medical Services of a Division, dated December 28, 1917.

Lieut.-Col. John V. Forrest, C.M.G., M.B., to be Temporary Colonel whilst employed as Deputy Director of Medical Services, Lines of Communication, dated December 24, 1917.

Col. John J. Gerrard, C.B., M.B., to be Surgeon-General, dated January 27, 1918.

The undermentioned Lieutenant-Colonel to be Temporary Colonel :—

James S. Gallie, D.S.O., whilst employed as Deputy Director of Medical Services, Lines of Communication, dated January 1, 1918.

The undermentioned Lieutenant-Colonels to be Temporary Colonels whilst employed as Assistant Directors of Medical Services of a Division :—

James A. Hartigan, D.S.O., M.B., dated January 3, 1918.

Henry G. Martin, dated January 4, 1918.

The undermentioned Surgeon-Generals are placed on the retired list :—

Dated January 18, 1918.—Surg.-Gen. Thomas J. O'Donnell, C.B., D.S.O.

Dated January 27, 1918.—Surg.-Gen. Sir W. G. Macpherson, K.C.M.G., C.B., M.B.

Dated January 31, 1918.—Surg.-Gen. Robert Porter, C.B., M.B.

Dated February 7, 1918.—Surg.-Gen. John Chislett Culling, C.B.

Temp. Lieut.-Col. Francis Robert Hill, Royal Army Medical Corps, to be a Deputy Assistant Director-General, vice Lieut.-Col. F. McLennan, who has vacated the appointment, dated January 21, 1918.

ROYAL ARMY MEDICAL CORPS.

Lieut.-Col. Brian Watts, D.S.O., relinquishes the rank of Temp. Col. on re-posting, dated July 23, 1917.

Lieut.-Col. Lawrence Humphry, C.M.G., to be Temp. Col. whilst employed as Assistant Director of Medical Services of a Division, dated December 5, 1917.

The undermentioned relinquish the acting rank of Lieutenant-Colonel on re-posting :—

Dated November 19, 1917.—Major Richard F. Ellery.

Dated November 30, 1917.—Capt. John H. Gurley.

The undermentioned to be Acting Lieutenant-Colonels whilst specially employed, dated October 9, 1917 :—

Major William W. Browne; Major Patrick Dwyer, M.C., M.B.

The undermentioned to be Acting Lieutenant-Colonels whilst in command of a Medical Unit :—

Dated November 19, 1917.—Major Richard C. Wilson, M.B.

Dated November 24, 1917.—Major John W. West, M.B.

Dated December 1, 1917.—Capt. Edmund W. Vaughan, M.B.

Dated December 4, 1917.—Major Charles G. Thomson, D.S.O.

The undermentioned Captains to be Majors, dated January 30, 1918 :—

Charles M. Drew, M.B.

Arthur G. Cummins, M.C., M.B.

Acting Lieut.-Col. Archibald S. Littlejohns, D.S.O.

William R. Galwey, M.C., M.B.

Robert G. Archibald, D.S.O., M.B.

Frank A. McCammon, M.C. M.B.

George De la Cour, M.B.

Acting Lieut. Col. William Egan, D.S.O., M.B.

Brevet Major Robert G. H. Tate, M.D.

Alexander Dawson, M.B.

Augustus S. Williams, D.S.O.

Victor C. Honeybourne.

Clive T. Edmunds.

Valentine G. Johnson.

Acting Lieut.-Col. Charles R. M. Morris, D.S.O., M.B.

Acting Lieut.-Col. Richard E. V. Newman, M.C., M.B.

Ernest W. M. Paine.

Frederick D. G. Howell, D.S.O., M.C.

Temp. Major Patrick Sampson, D.S.O.

Brevet Major Marcus G. Dill, M.D.

John B. Grogan.

Acting Lieut.-Col. Edward M. O'Neill, D.S.O., M.B.

Acting Lieut.-Col. Georgie B. Edwards, D.S.O.

Acting Lieut.-Col. John W. L. Scott, D.S.O.

William C. Smales, D.S.O.

Arthur H. Bond.

Thomas C. C. Leslie.

Donald de C. O'Grady.

Lawrence G. Gibson.

Philip S. Stewart, M.B.

Timothy W. O. Sexton.

Acting Lieut.-Col. Thomas T. H. Robinson, M.B.

The undermentioned retain the acting rank of Lieutenant-Colonel whilst commanding a Medical Unit, August 16, 1917 :—

Dated August 16, 1917.—Major Ernest B. Knox, M.D.

Dated September 9, 1917.—Major Phillip J. Maret. (Substituted for the notification in the *Gazette* of December 6, 1917.)

The undermentioned Captains to be Acting Lieutenant-Colonels whilst in command of a Medical Unit :—

Dated November 17, 1917.—Francis Casement, D.S.O., M.B.

Dated December 3, 1917.—John G. Gill, M.C., M.B.
 Capt. Arthur F. Heaton to be Major, dated November 27, 1917.
 Major James F. Martin, C.M.G., M.B., to be Temporary Lieutenant-Colonel whilst employed as Assistant Director of Medical Services, dated December 30, 1917.
 The undermentioned to be Acting Lieutenant-Colonels whilst in command of a Medical Unit:—
 Dated December 9, 1917.—Capt. Frank A. McCammon, M.C., M.B.
 Dated December 14, 1917.—Major Cuthbert G. Browne, D.S.O.
 Dated December 23, 1917.—Capt. Cyril Helm, M.C.
 The undermentioned Majors to be Lieutenant-Colonels, dated December 26, 1917:—
 Brevet Lieut.-Col. C. E. P. Fowler. | G. S. Mansfield, M.B.
 Brevet Lieut.-Col. H. A. Berryman.
 Major Edward L. Moss, M.C., retains the acting rank of Lieutenant-Colonel whilst specially employed, dated December 29, 1917.
 The undermentioned Lieutenants (Temp. Captains) to be Captains:—
 Dated February 5, 1918.—Evan Davies, M.B.; Robert E. Barnsley, M.C.
 Dated February 6, 1918.—Thomas J. Kelly, M.C., M.B.; Raymond J. Clausen, M.C., M.B.; Campbell McN. McCormack, M.C., M.B.
 Dated February 7, 1918.—George D. Jameson; Duncan W. Pailthorpe, M.C.; St. John D. Buxton.
 Dated February 8, 1918.—Ernest F. W. Grellier.
 Dated February 9, 1918.—Stanley Arnott, M.B.; Thomas L. Fraser, M.B.
 Dated February 10, 1918.—Lancelot G. Bourdillon, D.S.O., M.C.
 Dated February 12, 1918.—Acting Lieut.-Col. Richard A. Preston, M.C., M.B.; Arthur B. Preston.
 Dated February 13, 1918.—John Sainsbury, M.D.; Granville D. Robertson.
 Dated February 15, 1918.—Hamish D. F. Brand, M.B.
 Dated February 16, 1918.—Robert Ellis, M.C., M.B.; Francis G. A. Smyth; Joseph P. Little; Charles J. O'Reilly, M.C., M.B.
 The undermentioned Majors relinquish the acting rank of Lieutenant-Colonels on re-posting:—
 Dated October 30, 1917.—John H. Brunskill, D.S.O., M.B.
 Dated November 17, 1917.—George H. J. Brown, D.S.O., M.B.
 Dated December 12, 1917.—Benjamin H. V. Dunbar, D.S.O., M.D.
 Major Arthur E. S. Irvine, D.S.O., retains the acting rank of Lieutenant-Colonel whilst in command of a Medical Unit, dated December 4, 1917.
 The undermentioned to be Acting Lieutenant-Colonels whilst in command of a Medical Unit:—
 Dated November 13, 1917.—Major James C. G. Carmichael, M.B.
 Dated December 11, 1917.—Major Frank M. Parry, M.B.
 Dated December 14, 1917.—Capt. Ernest D. Caddell, M.C., M.B.
 Lieut. (Temp. Capt.) David C. Monro, M.B., to be Capt., dated February 17, 1918.
 The undermentioned Lieutenants (Temporary Captains) to be Captains, dated February 18, 1918:—
 William Foot, M.C., M.B.; Frederick C. K. Austin.
 The undermentioned Lieutenants (Temporary Captains) to be Captains, dated February 22, 1918:—
 A. E. Argo Galvin, M.B.; S. Crosse Spencer; W. Galloway Rudolf, M.B.
 Lieut.-Col. Basil F. Wingate, D.S.O., to be Temporary Col. whilst employed as Assistant Director of Medical Services of a Division, dated January 5, 1918.
 Major (Acting Lieut.-Col.) Norman E. Dunkerton relinquishes his acting rank on re-posting, dated January 14, 1918.
 Major Henry A. Bransbury, D.S.O., to be Acting Lieutenant-Colonel whilst in command of a Medical Unit, dated October 4, 1917.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE,
 ON FEBRUARY 27, 1918.

Present:

Surg.-Gen. Sir W. Donovan, K.C.B., one of the Trustees, in the chair.
 Surg.-Gen. Sir D. Bruce, K.C.B.
 Col. Sir J. Magill, K.C.B.
 Col. C. R. Tyrrel, C.B.
 Lieut.-Col. A. B. Cottell.
 Capt. H. H. Blake, Band President.

- (1) The minutes of the last meeting held on October 2, 1917, were read and confirmed.
- (2) The Secretary reported the separation of the accounts into two Branches, viz., Officers' Branch, and General Relief Branch, and also the present cash balances of the two branches, and

it was decided to invest £800 from the Officers' Branch and £300 from the Relief Branch in National War Bonds, the series to be decided after consultation with Messrs. Holt and Co.

(3) The accounts for the year 1917 were examined and approved subject to audit.

(4) The question of the payment of £2 5s. 6d., being expenses connected with the Commemoration Service for the First Seven Divisions, held at the Albert Hall on December 15, was considered, and it was decided to pay this amount from office expenses.

(5) The question was considered of payment of £12 12s., expenses incurred by Capt. J. T. Clapham in connexion with "Press Cuttings" relating to the Royal Army Medical Corps, which have appeared during the present War, and which were collected by him in accordance with a suggestion made by Surg.-Gen. M. Russell, at that time Deputy Director-General.

Payment was approved with a cordial vote of thanks to Capt. Clapham for all the trouble he had taken in the matter. Capt. Clapham, who was present at the meeting, was asked to communicate with the historian of the Medical History of the War as to the disposal of the cuttings already collected, and as to future action, and to report result at the next meeting.

(6) The Secretary reported five grants from the General Relief Branch to urgent cases amounting to £26 since the last meeting. Approved.

Also the return of a grant of £6 made to the widow of the late Cpl. Luker, resident at Gibraltar, voted at the last meeting, on the grounds that it was not then required; and the Secretary was directed to write to O.C.R.A.M.C., Gibraltar, asking him to communicate again should assistance in the case be required at any future time.

(7) The Secretary reported receipt of a Bearer Bond five per cent National War Bonds 1927 for £200 from R.A.M.C. depot, Blackpool, for the General Relief Branch. This has been invested in the names of the Trustees.

(8) An application was considered from the R.A.M.C. Comforts Fund for further assistance on account of the recent large increase in the number of prisoners of war of the Corps, and it was decided to grant £25 from the General Relief Branch.

(9) The Secretary requested authority to purchase the telephone which had been installed by the Auxiliary R.A.M.C. Fund at a cost of £4, and which was now left behind on the removal of that Fund to another office. Approved.

(10) The purchase of additional office furniture was approved, not exceeding £5, one-third being chargeable to each of the Branches of this Fund and the remaining third to the R.A.M.C. Benevolent Society.

(11) The Secretary reported that the office expenses for the year 1917 amounted to £186 4s. 11d., to be divided into three equal shares between the two Branches of this Fund and the R.A.M.C. Benevolent Society in accordance with the decision of the Annual General Meeting held on June 11, 1917, and it was decided to continue the present method of book-keeping in future, subject to the approval of the auditor.

(12) The President of the Band Committee presented the accounts for the Band, September to December, 1917, and applied for a grant of £100. Approved.

He also submitted an application for an increase of salary to the Band Master of £1 a month and to the Band Serjeant of 10s. a month, on account of the great increase of cost of living—such increase to be regarded as temporary and to be described as a "War Bonus."

A grant of £20 for this purpose was approved.

(13) The Secretary reported that no book existed showing the formation, constitution and objects of the Funds, which could be utilized for the information of all subscribers and as a permanent record; and he was authorized to prepare a rough draft of such a book with approximate cost of printing, and to make a report at the next meeting.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE,
ON FEBRUARY 27, 1918.

Present:

Surg.-Gen. Sir W. Donovan, K.C.B., one of the Trustees, in the Chair.

Surg.-Gen. Sir D. Bruce, K.C.B.

Lieut.-Col. A. B. Cottell.

Capt. J. T. Clapham.

(1) The Minutes of the last meeting held on October 9, 1917, were read and confirmed.

(2) The accounts for the year 1917 were examined and approved subject to audit.

(3) The Secretary was instructed to make inquiries as to the present value of the Railway Securities, and as to the advisability of the Society continuing to hold them.

(4) The Secretary reported new members joining and the present cash balance of the Fund, and was directed to make inquiries as to the best method of circularizing officers on the active list, with a view of making the existence of the Society more widely known, and obtaining a larger number of subscribers. The necessary expenditure on printing, postage, etc., was approved.

(5) Applications from orphans which had been received were considered and small grants made under Rule 24 were approved to be made.

(6) The question of sending out application forms to orphans to whom grants had been issued last year was considered, and it was decided to issue these forms accompanied in each case by a letter stating that this action was not to be regarded as a guarantee that any grant would be made.

(7) The Secretary reported two grants of £10 each which had been made to applicants in very urgent cases since the last meeting under Rule 31. Approved.

(8) The Secretary reported that the office expenses for the last year in accordance with the decision of the last Annual General Meeting had amounted to £62 1s. 8d., viz., one third of the total expenditure of the Royal Army Medical Corps Fund (two branches) and this Society; and it was agreed that the present method of book-keeping should be continued subject to the approval of the auditor.

(9) The Secretary reported that Messrs. Sir Charles McGrigor, Bart., and Co., had recovered the Income Tax for the year 1917 free of charge, and that he had written on behalf of the Committee to Sir Charles McGrigor, Bart., and Co., expressing his cordial thanks for their kind assistance.

(10) A grant for the purchase of additional office furniture was approved, one third being payable by this Society, the total not to exceed £5.

ROYAL ARMY MEDICAL CORPS COMFORTS FUND.

THE HONORARY SECRETARY'S REPORT FOR 1917.

THE first part of 1917 we were fortunate enough to have no men of the Royal Army Medical Corps prisoners of war in Germany. Working under the rules of the Central Prisoners of War Committee we have sent since the beginning of January, three parcels of food a fortnight to all men of the Royal Army Medical Corps who are prisoners of war in Germany.

According to regulations these parcels contain 10 pounds weight of food, and are of an average cost of 9s. each; some of the contents are: tinned meats of various kinds, fish, cocoa, cheese, milk, vegetables, fruit, jam, syrup, biscuits, butter, margarine, dripping, puddings, condiments, etc., and packets of flour, sugar, tea, quaker oats, cornflour, soup squares, and many other useful articles of food. A fortnightly supply of tobacco and cigarettes is sent, out of Bond, direct to each man. Bread also is sent each week from Copenhagen to the men in Germany. Clothing parcels are sent out every six months. Altogether about 1,000 parcels of food and clothing (exclusive of tobacco and bread) have been sent out from our packing rooms during 1917. Twice in the year parcels to Turkey have been stopped; during these periods we have sent postal orders for 5s. a week to our prisoners of war, the money reached the men fairly satisfactorily.

As parcels do not by any means, all arrive in Turkey, the Committee decided that only one parcel and 10s. in money in lieu of the other parcels should be sent each fortnight. This course has been followed these last few months, the money being sent through the Comité Internationale de la croix rouge in Geneva. Sufficient time has not elapsed for us to judge the result of this experiment. As the number of prisoners of war has considerably increased, and the difficulties in procuring foods become greater daily, the cost of the parcels increases correspondingly. The Committee hope they will be given sufficient support to enable them to continue caring for the men of the Corps during the coming year.

All Royal Army Medical Corps Men, Regulars, New Army, Special Reserve, and Territorial, are under the care of the Royal Army Medical Corps Comforts Fund. Sometimes Territorial County Associations wish to look after and provide for all men belonging to their county Units. In these cases we transfer the men to the Territorial Prisoners of War Fund for all parcels, excepting bread, which is in all cases invariably supplied by us, at a cost of 1s. 10d. per week per man.

Owing to our Prisoners of War work having so greatly increased, we have not been able to send as many comforts as formerly to the Medical Units overseas—altogether, only about 150 bales, each of fifty-five pounds weight, have been dispatched to Salonika, Mesopotamia and Egypt, and a few dozen consignments of games to Units in France who especially asked to be so supplied.

Lieut.-Col. E. M. Wilson, who has kindly acted as Honorary Treasurer since Lieut.-Col. Harris's death, will submit the Balance Sheet for publication in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.

The work depots in Edinburgh and Trenock still help splendidly in supplying comforts, and another has recently been started in Blackpool with the same object. The working party which was organized last December meets once a week, and has helped splendidly with making large numbers of shirts, socks, etc.: all materials have been supplied by donations from the ladies themselves.

Lady Sloggett and the Central Ladies Committee for Royal Army Medical Corps Comforts

ROYAL ARMY MEDICAL CORPS COMFORTS FUND.

STATEMENT OF ACCOUNTS FOR 1917.

RECEIPTS.		£	s.	d.	EXPENDITURE.		£	s.	d.		
Balance in hand, December 31, 1916	60	14	9	Gameage, Ltd.	..	..	38	19	2
Grants and Donations, 1917	1,280	3	9	Army and Navy Stores	..	..	138	18	9
						Derry and Toms, Ltd.	..	..	52	7	9
						Empire Service	..	..	141	12	1
						G. W. Dray and Son	..	..	6	18	6
						Drayton Paper Mills	..	..	9	9	6
						Watford Manufacturing Company	..	..	5	14	0
						N. Hants Printing Company	..	..	9	1	6
						G. W. Railway Company	..	..	1	5	5
						Mrs. Morgan: Imprest Account	..	..	38	0	0
						Lipton, Ltd.	..	..	11	7	0
						Messrs. J. H. Swainston	..	..	131	16	11
						Nestle's Milk Company	..	..	30	9	2
						Messrs. G. F. Wyatt	..	..	11	2	4
						Walkers' Tobacco Market	..	..	17	19	7
						<i>Liverpool Courier</i>	..	..	1	2	6
						Bankers' Charges	..	..	1	5	5
						Stamps	..	..	1	0	0
						Prisoners of War Comforts, &c.	..	..	74	11	9
									£723	1	4
						Cheques not yet paid in	..	..	6	0	0
									£717	1	4
						Balance as per Pass Book	..	..	628	17	2
									£1,340	18	6

In addition Mrs. Morgan has in hand £2 8s. 9d. Petty Cash.

Examined and found correct,
(Signed) EDMOND T. GANN.

February 22, 1918.

wish to thank all who have so kindly helped them in the past, and they hope for a continuance of their support so as to enable them to maintain their work for the prisoners of war.

All money donations should be sent to—

The Honorary Secretary,
R.A.M.C. Comforts Fund,
R.A.M.C. College,
Grosvenor Road, London, S.W. 1.
(Signed) ELEANOR MORGAN, *Hon. Secretary.*
December 31, 1917.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

SUMMARY OF THE PROCEEDINGS OF THE QUARTERLY MEETING HELD AT THE ROYAL ARMY MEDICAL COLLEGE, ON WEDNESDAY, JANUARY 23, 1918.

Present:—

Dep. Surg.-Gen. W. G. Don, Vice-President, in the Chair.
Lieut.-Col. G. S. Mansfield.
The Secretary.

The Minutes of the previous meeting were read and confirmed.

Lieut. (Temp. Capt.) A. E. Richmond was admitted a married member of the Society at an annual subscription of £12 10s. 8d., together with an extra war charge of £26 5s. per annum.

The death was reported of Lieut.-Col. D. B. Miller, an unmarried member, and of Capt. W. F. Bailey, a married member. The resignation was reported of Lieut.-Col. W. M. Herman, an unmarried member.

A certificate was submitted from the Actuary that the Stock Exchange Securities held by the Society were Trustee Securities on December 31, 1917.

The Secretary reported that £3,000 five per cent National War Bonds had been taken up in December, 1917, out of cash balances, as advised by Sir James McGrigor and Mr. Andras.

A letter from Lieut.-Col. R. J. L. Fayle, D.S.O., was read in which he regretted that his duties did not allow his attendance at meetings of the Committee. The Secretary was directed to make inquiry as to members available to fill vacancies on the Committee.

Payment of the Actuary's fee (£10 10s.) for the year 1917 was sanctioned, as was that of the Secretary's salary for the past quarter.

3, Homefield Road,
Wimbledon, S. W.

J. T. CLAPHAM, *Captain,*
Secretary.

Note.—This Fund provides annuities of £50 a year (together with any additional benefits which may be available from distribution of surplus which at present, in the majority of cases, amount to a bonus of £200 to the widow) to the widows of subscribers and to their children under 21 years of age. The annual subscription varies according to the ages of husband and wife: e.g. in the case of a husband aged 30, and wife aged 25, it would amount to £14 18s. 6d.; where husband and wife were both aged 28 it would be £12 19s. 11d. At the outbreak of war an additional war charge of 50 guineas per annum was made, and eligibility for membership was limited to officers on the strength of the Corps on that date.

The death rate amongst officers of the Corps having been lower in the later stages of the war than was expected the Committee have been able to reduce the extra war charge to one of 25 guineas per annum, in addition to the normal annual subscription according to scale. It has also been resolved that officers gazetted to permanent commissions in the Corps on January 1, 1917, and up to May 22, 1917, shall be eligible for membership on the above terms. The cases of those who may be gazetted later will be considered as they arise.

The Secretary will be glad to give any further information as to details.

BIRTHS.

SKRIMSHIRE.—On January 14, 1918, at Bangalore, South India, the wife of Captain F. R. B. Skrimshire, R.A.M.C., of a son.

ELLIOT.—On February 17, 1918, at Southsea, Hants, the wife of Captain E. J. Elliot, R.A.M.C., of a daughter.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

NUMBER OF REPRINTS	NUMBER OF PAGES	COST OF REPRINTS		COST OF EXCERPTS *		EXTRA FOR COVERS FOR REPRINTS			
		£	s. d.	£	s. d.	As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
12	4	0	2 9	0	1 2	4 3	1 1	3 10	0 9
	8	0	5 0	0	2 3				
	16	0	8 3	0	3 11				
25	4	0	3 4	0	1 5	4 10	1 6	4 4	0 11
	8	0	6 0	0	2 9				
	16	0	10 6	0	5 0				
50	4	0	4 6	0	1 10	6 0	2 1	4 10	1 2
	8	0	7 6	0	3 6				
	16	0	13 3	0	5 10				
100	4	0	6 0	0	3 1	7 10	3 11	6 7	2 5
	8	0	10 0	0	4 10				
	16	0	18 6	0	7 6				
200	4	0	9 6	0	4 5	10 10	7 6	9 0	4 10
	8	0	15 0	0	6 7				
	16	1	6 0	0	9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. net; binding, 2s.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C.

The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adastral House, Victoria Embankment, E.C. 4.

The following publications have been received:—

British: The Practitioner, The Medical Journal of Australia, The Royal Engineers' Journal, The Hospital, Tropical Diseases Bulletin, Guy's Hospital Gazette, Transactions of the Society of Tropical Medicine and Hygiene, The Medical Press and Circular, The Saturday Review, Edinburgh Medical Journal, St. Bartholomew's Hospital Journal, Annals of Tropical Medicine and Parasitology, The Veterinary Review.

Foreign: Office International d'Hygiène Publique, Annali di Medicina Navale e Coloniale, The Military Surgeon, Bulletin of the Johns Hopkins Hospital, Bulletin de la Société de Pathologie Exotique, Archives Médicales Belges, Memorias do Instituto Oswaldo Cruz, United States Public Health Service.

Communications have been received from Lieut.-Col. J. Stony Archer.

MANAGER'S NOTICES.

The **JOURNAL OF THE ROYAL ARMY MEDICAL CORPS** is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,

"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"

25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C. 4.

JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.

Corps News.

MARCH, 1918.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
February 23, 1918.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-Commissioned Officers and Men :—

No. 1598 Serjt. R. W. Smith, M.M., Royal Army Medical Corps (Gateshead-on-Tyne). (M.M. gazetted June 3, 1916.)

No. 42093 Pte. (Acting Lance-Cpl.) E. J. Trim, M.M., Royal Army Medical Corps (Frampton). (M.M. gazetted August 23, 1916.)

No. 421062 Pte. W. J. Fryer, M.M., Royal Army Medical Corps (Wolverhampton). (M.M. gazetted November 11, 1916.)

No. 57417 Serjt. J. McL. Donald, M.M., Royal Army Medical Corps (Forfar). (M.M. gazetted November 16, 1916.)

No. 6434 Cpl. (Acting Lance-Serjt.) T. Waterman, M.M., Royal Army Medical Corps (Gillingham). (M.M. gazetted December 9, 1916.)

No. 57780 Serjt. T. Wood, M.M., Royal Army Medical Corps (Bermondsey). (M.M. gazetted March 12, 1917.)

No. 65457 Serjt. B. W. Gunn, M.M., Royal Army Medical Corps (Sudbury). (M.M. gazetted June 18, 1917.)

No. 46951 Cpl. H. Scandrett, M.M., Royal Army Medical Corps (Islington).

No. 38024 Cpl. (Acting Serjt.) C. E. Brooker, M.M., Royal Army Medical Corps (Tunbridge Wells).

No. 508435 Pte. H. Tanton, M.M., Royal Army Medical Corps (Wembley). (M.M. gazetted July 18, 1917.)

No. 70884 Pte. W. Booth, M.M., Royal Army Medical Corps (Denton).

No. 301288 Lance-Serjt. (Acting Serjt.) T. B. Elmslie, M.M., Royal Army Medical Corps (Aberdeen).

No. 305181 Serjt. A. Gorrie, M.M., Royal Army Medical Corps (Dundee). (M.M. gazetted December 17, 1917.)

No. 341263 Pte. O. Dolan, M.M., Royal Army Medical Corps (St. Helens). (M.M. gazetted in present Gazette.)

His Majesty the King has been graciously pleased to confer the Military Medal for Bravery in the Field to the undermentioned Non-Commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 45514 Pte. A. C. Amey (Southfields).

No. 33703 Pte. C. J. Ashman (Putney, S.W.).

No. 35408 Pte. A. Bagshaw (Birmingham).

No. 40729 Pte. (Acting Cpl.) W. Baseley (Birmingham).

No. 7594 Pte. W. H. Beake (Portsmouth).

No. 386076 Pte. C. N. Bell (Newcastle-on-Tyne).

No. 386262 Pte. N. Bell (Rowlands Gill).

No. 339119 Pte. J. Blake (Liverpool).

No. 49069 Pte. H. Bland (Bury).

No. 386031 Pte. F. Bredin (Newcastle-on-Tyne).

No. 74626 Pte. W. Bridgford (Stourport).

No. 390530 Pte. H. L. Brown (Hull).

No. 459037 Pte. A. Burrige (Plymouth).

- No. 405267 Pte. H. Carter (Sheffield).
 No. 388420 Pte. E. W. Coatsworth (Bishop Auckland).
 No. 61603 Pte. J. Cooper (Portsmouth).
 No. 386350 Pte. R. Cruddace (North Easington Colliery).
 No. 35791 Cpl. A. Davies (Rock Ferry).
 No. 58054 Pte. E. M. Davies (Aberdare).
 No. 4604 Pte. B. Dempster (Darlington).
 No. 459431 Pte. P. J. Doidge (Torquay).
 No. 341263 Pte. O. Dolan (St. Helens).
 No. 386128 Pte. T. W. Farbridge (Newcastle).
 No. 31842 Pte. C. Farrell (Dublin).
 No. 7265 Pte. J. C. Finigan (Portsmouth).
 No. 20294 Pte. W. Fish (Manchester).
 No. 44672 Pte. M. Gaffney (Cowdenbeath).
 No. 388109 Serjt. C. W. Garraway (Bishop Auckland).
 No. 386057 Pte. H. Graham (Newcastle).
 No. 322083 Pte. J. Graham (Glasgow).
 No. 30808 Pte. J. Grierson (Middlesbro').
 No. 37016 Pte. A. Hall (Leeds).
 No. 64877 Pte. A. Hamilton (Stevenston).
 No. 66607 Pte. F. Hamlin (Exminster).
 No. 56484 Pte. (Acting Lance-Cpl.) J. Hancock (Rugeley).
 No. 52295 Serjt. H. E. Hardy (Upper Clapton).
 No. 45772 Pte. J. C. Harradine (Quorn).
 No. 103741 Pte. H. Haslam (Bolton).
 No. 18344 Pte. (Acting Serjt.) A. Hayden (Leyton).
 No. 80445 Pte. W. H. Heath (Caversham).
 No. 50426 Pte. G. Henson (Derby).
 No. 56668 Pte. J. Hughes (Market Drayton).
 No. 8980 Pte. W. Kelly (South Shields).
 No. 390156 Pte. T. Kennedy (Hull).
 No. 106029 Pte. F. R. Kennerley (Hale).
 No. 36049 Serjt. A. Killan (Oldham).
 No. 339149 Serjt. J. A. Mason (Liverpool).
 No. 7838 Pte. J. McEwen (Ayr).
 No. 301052 Lance - Cpl. P. M. Morrison (Aberdeen).
 No. 53896 Pte. T. Muir (Sauchie, by Alloa).
 No. 390361 Pte. W. C. P. Nixon (Redcar).
 No. 714 Pte. (Acting Cpl.) W. Parry (Merthyr Tydvil).
 No. 81113 Pte. A. Petrie (Blairgowrie).
 No. 42062 Serjt. (Acting Serjt.-Major) W. J. Post (Redhill).
 No. 39642 Pte. H. E. Prescott (Birmingham).
 No. 3061 Pte. S. Price (Birmingham).
 No. 38401 Lance-Cpl. W. Purves (Peebles).
 No. 68333 Pte. F. M. Rackham (Dalston).
 No. 91687 Pte. S. R. J. Rattey (Camberwell).
 No. 20551 Pte. M. Reed (Kendal).
 No. 33170 Pte. W. H. Reid (Brixton).
 No. 78760 Pte. T. Richardson (Middlesbro').
 No. 459376 Pte. (Lance-Cpl.) W. E. Robbins (Falmouth).
 No. 352312 Pte. W. Robinson (Padiham).
 No. 352587 Pte. M. Rowe (Preston).
 No. 386257 Pte. E. V. Smith (Newcastle).
 No. 74364 Pte. G. V. Snell (Birmingham).
 No. 29234 Pte. E. Spencer (Barwell).
 No. 43171 Pte. W. E. Strickland (Barnoldswick).
 No. 64087 Cpl. (Acting Serjt.) A. Swindall (Doncaster).
 No. 2368 Pte. L. Symons (Mile End, E.).
 No. 58470 Pte. (Acting Serjt.) C. F. M. Taylor (Mapperley).
 No. 73611 Pte. E. Taylor (Newcastle-on-Tyne).
 No. 386109 Pte. J. Taylor (Newcastle).
 No. 37650 Lance-Cpl. J. W. Taylor (Askington).
 No. 388282 Pte. T. L. Taylor (Gateshead-on-Tyne).
 No. 410103 Pte. W. H. Tingle (Sheffield).
 No. 405424 Pte. W. H. Tradewell (Bolsover).
 No. 46510 Serjt. G. B. Trim (Deal).
 No. 45389 Pte. (Acting Cpl.) L. O. Walford (Plumstead).
 No. 3782 Pte. (Acting Lance-Cpl.) J. R. Wells (Landport).
 No. 55006 Pte. W. J. Whittaker (Stafford).
 No. 90134 Serjt. A. M. Wilson (Glasgow).
 No. 20514 Pte. J. H. Woodward (Leigh).
 No. 30345 Pte. A. H. Williams, Royal Welsh Fusiliers (Lampeter).

War Office,
 February 27, 1919.

ADDITIONAL MENTIONS IN DISPATCHES.

The following names are added to the List of Officers, Ladies, Non-commissioned Officers and Men recommended for Distinguished and Gallant Services and Devotion to Duty in the dispatch from the Field-Marshal Commanding-in-Chief, the British Armies in France, dated November 7, 1917, which was published in the *London Gazette* dated December 11, 14, 18, 21, 24 and 28, 1917:—

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. H. D. Field (died of wounds).
 Temp. Capt. K. T. Limbery (killed).—

CORRIGENDA TO "MENTIONS IN DISPATCHES."

British Armies in France Dispatches.

Under Army Medical Service (page 13483).
 Col. (Temp. Surg.-Gen.) C. H. Burtchaell, C.B., C.M.G., M.B.
 Under Royal Army Medical Corps (page 13485-; 3486).
 Capt. (Acting Lieut.-Col.) C. S. Brebner, M.D.
 No. 47040 Staff Serjt. D. Moffatt.

War Office,
March 4, 1918.

His Majesty the King has been pleased to confer the undermentioned rewards for Gallantry and Distinguished Service in the Field. The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable:—

AWARDED A BAR TO THE MILITARY CROSS.

Temp. Capt. George Lestock Thornton, Royal Army Medical Corps. (M.C. gazetted January 1, 1918.)

AWARDED THE MILITARY CROSS.

Temp. Capt. Robert Daniels Bell, Royal Army Medical Corps.

Amendments.

The following are the correct descriptions of the Officer and Non-Commissioned Officer upon whom rewards have recently been conferred:—

Capt. John Elvin Rusby, M.C., Royal Army Medical Corps, Special Reserve. (M.C. gazetted September 26, 1917.)

No. 17933 S. M. David Edward Dean, M.C., Royal Army Medical Corps. (M.C. gazetted January 1, 1918.)

His Majesty the King has been pleased to award the Distinguished Conduct Medal to the undermentioned for Gallantry and Distinguished Service in the Field:—

No. 40508 Serjt. T. Ashmore, M.M., Royal Army Medical Corps (Somerford).

For conspicuous gallantry and devotion to duty in charge of bearers. He led three parties of stretcher-bearers through heavy shell fire to clear R.A. P's. He was wounded in the arm while bringing in a wounded man, and later on gassed, but continued to perform his duties until ordered to withdraw.

No. 401452 Serjt. F. Beevers, M.M., Royal Army Medical Corps (Leeds).

For conspicuous gallantry and devotion to duty. He worked at a regimental aid post during an action, and by his courage and example kept his workers working day and night until all cases were cleared. He passed several times through an intense enemy barrage, and it was largely owing to his determination and initiative that all the wounded were got away.

No. 27821 Serjt. A. Blandford, Royal Army Medical Corps (Newport).

For conspicuous gallantry and devotion to duty during a heavy bombardment of gas and H.E. shells. He led a party of stretcher-bearers to the rescue of some gunners whose dug-outs had been blown in. At great personal risk they succeeded in digging them out and rescued three alive. It was due to his initiative, courage and energy that three lives were saved.

No. 37128 Cpl. (Acting Serjt.) A. C. Cardy, M.M., Royal Army Medical Corps (Bridlington).

For conspicuous gallantry and devotion to duty while in charge of forward bearers. He superintended the evacuation of the wounded under continuous heavy fire and over almost impassable ground, remaining at his work until all the wounded were cleared, although wounded himself.

No. 493593 Lance-Serjt. J. Cassingham, Royal Army Medical Service (Gravesend).

For conspicuous gallantry and devotion to duty. He reconnoitred an advanced position under heavy fire, searching for wounded men. He then led forward a bearer party and brought in the wounded, making three journeys, each of which occupied three hours. He set a splendid example of determination and resource.

No. 497305 Staff-Serjt. R. O'Nions, Royal Army Medical Corps (Coulson).

For conspicuous gallantry and devotion to duty. He worked with untiring energy for several days, removing the wounded under most difficult conditions. When the remainder of his party were casualties he worked alone for several hours until overcome by gas. It was largely due to his splendid example that the evacuation of the wounded was successfully carried out.

3rd Class Asst.-Surg. R. H. F. Parkinson, I.S.M.D.

For conspicuous gallantry and devotion to duty. Throughout the action he remained in close contact with the fighting troops, and by his cool courage and professional skill the wounded were dressed and evacuated with the utmost dispatch. Though the heat was intense, he performed magnificent work.

No. 1998 Serjt. E. Patrick, M.M., Royal Army Medical Corps (Leeds).

For conspicuous gallantry and devotion to duty in charge of a relay post for three days. He worked without ceasing, collecting and evacuating wounded under heavy shell fire, and so saved the lives of many men.

No. 32509 Pte. (Acting-Serjt.) R. G. Wardrop, M.M., Royal Army Medical Corps (Hartley Wintney).

For conspicuous gallantry and devotion to duty when in charge of a bearer-post. He got all he wounded away from his post under intense shell fire, and in spite of casualties among the

bearers, working in the open in utter disregard of danger. He set a magnificent example of courage and untiring energy.

No. 39168 Staff-Serjt. O. Williams, Royal Army Medical Corps (Pontypridd).

For conspicuous gallantry and devotion to duty when a dug-out at a forward post was blown in during an action. He was the first on the spot assisting to extricate the wounded under very heavy shell fire. When both the officers at the post were wounded he took command, controlling the evacuation of the wounded with great skill. His coolness and disregard of self were a stirring example.

No. 4977 Pte. (Acting Serjt.) W. Wilson, Royal Army Medical Corps (Dundee).

For conspicuous gallantry and devotion to duty. When casualties were caused at a position which was subjected to a heavy bombardment he at once organized a party of bearers, hastened to the spot, and succeeded in rescuing a wounded officer under heavy fire. Later, he rendered most valuable service in helping to rescue two men who had been buried in a dug-out. On many other occasions he displayed courage and coolness of a high order.

War Office,
March 7, 1918.

The following dispatch has been received by the Secretary of State for War from Major-General A. R. Hoskins, C.M.G., D.S.O., late Commanding-in-Chief, East Africa Force:—

General Headquarters,
East Africa Force.
May 30, 1917.

My Lord,—I beg to forward herewith lists of those whom I recommend for mention in dispatches.

I have the honour to be, my Lord,
Your obedient Servant,
A. R. HOSKINS, *Major-General*.

STAFF.

Major R. T. Brown, D.S.O., M.D., Royal Army Medical Corps.

MEDICAL SERVICES.

Royal Army Medical Corps.

Capt. R. S. Armour, M.B.
Capt. G. B. Fleming, M.B.
Capt. J. D. Kidd, M.B.
Capt. J. J. D. La Touche, M.B., Special Reserve.
Capt. (Acting Major) W. A. MacLennan, M.B., Special Reserve.
Major (Temp. Lieut.-Col.) A. McMunn.
Temp. Major R. T. Meadows, D.S.O., M.D. (late Surgeon-Major Army Medical Reserve of Officers).
Capt. W. Mitchell, M.B.

Capt. B. Varvill.
Temp. Capt. A. M. Webber, F.R.C.S.
No. 50899 Cpl. (Acting Serjt.) F. Bray.
No. 36708 Pte. J. Brockless.
No. 6893 Pte. A. Chubb.
No. 60272 Pte. O. J. Gray (deceased).
No. 36717 Pte. E. Iredale.
No. 36719 Pte. W. Jackson.
No. 1643 Serjt. (Acting Staff-Serjt.) F. H. Mattock.
No. 1375 Serjt. H. Shipton.
No. 36729 Pte. J. Sidebottom.

The following dispatch has been received by the Secretary of State for War from Lieut.-Gen. J. L. Van Deventer, K.C.B., Commanding-in-Chief, East Africa Force:—

General Headquarters,
East Africa Force,
October 11, 1917.

My Lord,—I beg to forward herewith the names of those Officers, Non-commissioned Officers and Men of the Forces under my command whom I wish to bring to your notice for Meritorious Service in the Field.

I have the honour to be, my Lord,
Your most obedient Servant,
J. VAN DEVENTER, *Lieut.-Gen.*,
Commanding-in-Chief, East Africa Force.

STAFF HEADQUARTERS, &c.

Col. G. D. Hunter (Temp. Surg.-Gen.), C.B., C.M.G., D.S.O., Army Medical Service.
Lieut.-Col. C. J. O'Gorman, D.S.O., Royal Army Medical Corps.
Lieut.-Col. (Temp.Col.) G. W. Tate, D.S.O., M.B., Royal Army Medical Corps.
No. 63131 Pte. H. Birchall, Royal Army Medical Corps.

ROYAL ARMY MEDICAL CORPS.

Capt. R. P. Cormack, M.B.
Temp. Qmr. and Hon. Lieut. E. J. Harris.
Major H. Hemsted.
Capt. P. E. Lander.
Temp. Capt. D. McIntyre, M.B.
Capt. E. S. Walls, Special Reserve.

Temp. Capt. A. McP. Warner, M.D.
No. 68999 Pte. E. Ainscow.
No. 54514 Pte. P. A. Mudd.
No. 322008 Cpl. (Acting Serjt.) W. Paterson.
No. 4569 Serjt. L. Richardson.

NYASALAND LOCAL FORCES.

Medical Corps.

Capt. A. P. M. Anderson.
Major (Acting Lieut.-Col.) W. Gilbert, M.B.,
F.R.C.S.
Capt. A. McW. Green.
Capt. (Temp. Major) F. S. Jones.
Capt. (Temp. Major) W. D. Miller, M.B.
Temp. Capt. A. F. H. Rabagliati, M.D.

Lieut.-Col. T. Smythe.
No. 365 Staff-Serjt. T. J. Burke.
No. 836 Pte. A. Chapman.
No. 2012 Staff-Serjt. C. J. Eales.
No. 1269 Pte. (Acting Serjt.) E. F. Earl
No. 1294 Staff-Serjt. W. D. Jackson.
No. 810 Staff-Serjt. A. S. Whittaker.

War Office,
March 12, 1918.

The Secretary of State for War has received the following dispatch, addressed to the Chief of the General Staff, India, by Lieut.-General Sir Stanley Maude, K.C.B., Commanding-in-Chief, Mesopotamian Expeditionary Force:—

General Headquarters,
Mesopotamian Expeditionary Force,
November 2, 1917.

SIR,—With reference to the concluding paragraph of my dispatch dated October 15, 1917, I have the honour to submit herewith a list of names of those Officers, Ladies, Non-Commissioned Officers and Men serving, or who have served, under my command, whose distinguished and gallant services and devotion to duty I consider deserving of special mention.

I have the honour to be, Sir,

Your obedient Servant,
F. S. MAUDE,
Lieut.-General,
Commanding-in-Chief,
Mesopotamian Expeditionary Force.

Col. (Temp. Surg.-Gen.) A. P. Blenkinsop, C.B., Army Medical Service.

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. R. C. Begg, M.B.
Capt. W. H. Biggs (Territorial Force).
Lieut.-Col. J. H. R. Bond, D.S.O.
Capt. T. K. Boney, M.D., Special Reserve.
Capt. A. E. Bonham (Territorial Force).
Temp. Lieut. D. F. Borrie.
Temp. Capt. T. P. Buist, M.B.
Major (Acting-Lieut.-Col.) G. E. Cathcart, M.B.
Capt. J. W. Dalglish, M.B., Special Reserve.
Temp. Major (Temp. Lieut.-Col.) R. Davies-Colley, F.R.C.S.
Temp. Lieut. G. Dougan, M.D.
Capt. W. Dunlop, M.B., Special Reserve.
Lieut. J. Ewing.
Brevet-Col. M. H. G. Fell, C.M.G.
Capt. M. Foster, M.B., Special Reserve.
Lieut.-Col. (Temp. Col.) S. F. St. D. Green, M.B.
Capt. D. R. Hennessy, Special Reserve.
Temp. Qmr. and Hon. Lieut. C. Hunt.
Capt. T. P. Inglis, M.B., Special Reserve.
Capt. C. M. Ingoldby.
Temp. Capt. T. S. Keith, M.B., late Royal West Surrey Regt.
Capt. J. de M. Kneebone, M.B., Special Reserve.
Temp. Lieut. A. C. Lambert, M.D.
Capt. J. W. MacLean, M.B.
Capt. and Brevet-Major W. McNaughton.
Temp. Qmr. and Hon. Lieut. C. E. Malyon.

Temp. Capt. G. S. Marshall.
Capt. J. P. Mitchell, M.D., Special Reserve.
Capt. W. K. Morrison, D.S.O., M.D.
Temp. Capt. V. E. Negus.
Temp. Capt. C. J. B. Pasley.
Temp. Capt. A. Poole, M.B.
Temp. Capt. N. N. Purkis.
Lieut. (Temp. Capt.) H. P. Rudolf, M.B.
Brevet-Lieut.-Col. D. S. Skelton, D.S.O.
Brevet-Col. J. M. Sloan, C.M.G., D.S.O., M.B.
Capt. G. N. Smyth, Special Reserve.
Temp. Capt. R. Y. Stones, M.B., F.R.C.S. Edin.
Temp. Capt. G. S. Terry.
Major (Acting Lieut.-Col.) L. F. Whelan, M.B.
Lieut.-Col. W. A. Woodside, D.S.O.
No. 75963 Pte. G. Ambler.
No. 34007 Qmr.-Serjt. G. C. Bester.
No. 500060 Lance-Cpl. E. Brooke, 2nd East General Hospital (Territorial Force).
No. 35737 Cpl. J. B. Brown.
No. 464004 Serjt. (Acting Staff-Serjt.) W. E. Dalling, No. 101, Sanitary Section (Territorial Force).
No. 16317 Pte. S. Davenport.
No. 97966 Pte. (Acting Lance-Cpl.) W. Drummond.
No. 328019 Pte. C. Fischbacker, 4th Section General Hospital (Territorial Force).

- No. 2686 Lance-Cpl. R. C. Ford, Devon Regt.
 No. 27848 Serjt. W. Greenwood.
 No. 954 Serjt. H. C. Hallett.
 No. 23542 Serjt. A. E. Hughes.
 No. 14926 Serjt.-Major W. H. G. Hunt.
 No. 4435 Pte. J. G. Hunter.
 No. 32621 Pte. (Acting-Serjt.) A. Johnson.
 No. 25648 Serjt. H. J. Jones.
 No. 24351 Pte. W. P. Kelly.
 No. 12002 Staff-Serjt. (Acting Staff-Serjt.-Major) W. J. Knee.
 No. 69958 Serjt. (Acting Staff-Serjt.) H. Latter.
 No. 545356 Pte. (Acting Cpl.) T. H. Legge.
 No. 505021 Staff-Serjt. A. Longstaff.
 No. 464006 Cpl. B. M. Luxmore.
 No. 17857 Qmr.-Serjt. (Acting Serjt.-Major) A. E. Macklen.
 No. 751 Staff-Serjt. (Acting Qmr.-Serjt.) A. J. Milne.
 No. 76141 Pte. J. E. Price.
 No. 97911 Pte. J. Rudd.
 No. 464001 Lance-Cpl. (Acting Lance-Serjt.) S. J. Smith.
 No. 24681 Serjt. (Acting Staff-Serjt.) W. Smith.
 No. 35559 Pte. (Acting Serjt.) E. G. Tilt.
 No. 505004 Pte. (Acting Lance-Cpl.) H. Tunbridge.
 No. 70345 Pte. W. H. Wheele.

ARMY MEDICAL SERVICE.

Major-Gen. T. H. J. C. Goodwin, C.M.G., D.S.O., from Deputy Director-General, to be Director-General (Temporary), and to be Temporary Lieutenant-General vice Lieut.-Gen. Sir A. Keogh, G.C.B., M.D., F.R.C.P. (retired pay), dated March 1, 1918.

Col. G. B. Stanistreet, C.M.G., from an Assistant Director-General to be Deputy Director-General (Temporary), and to be Temporary Major-General, dated March 1, 1918.

Col. J. R. McMunn, C.M.G., to be Assistant Director-General (Temporary), vice Col. G. B. Stanistreet, dated March 1, 1918.

The undermentioned notifications will have effect from the dates on which the officers named were promoted substantive or temporary Surgeon-Generals, ranking as Lieutenant-General or Major-General respectively:—

Surg.-Gen. (ranking as Lieut.-Gen.) Sir A. T. Sloggett, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., K.H.S., to be Lieutenant-General, dated June 1, 1914.

The undermentioned Surgeon-Generals (ranking as Major-Generals), to be Major-Generals, with effect from the date of their appointments as Surgeon-Generals:—

- | | |
|--|--|
| Sir W. Babbie, V.C., K.C.M.G., C.B., M.B. | W. T. Swan, C.B., M.B. |
| K.H.S. | G. Cree, C.B., C.M.G. |
| L. E. Anderson, C.B. | H. Carr, C.B., M.D. |
| H. G. Hathaway, C.B. | A. A. Sutton, C.B., D.S.O. |
| W. G. A. Bedford, C.B., C.M.G., M.B. | M. T. Yarr, K.C.M.G., C.B., F.R.C.S.I. |
| M. W. O'Keeffe, C.B., M.D. | C. H. Burtchaell, C.B., C.M.G., M.B. |
| W. G. Birrell, M.B. | T. H. J. C. Goodwin, C.M.G., D.S.O. |
| F. J. Jencken, C.B., M.B. | J. J. Gerrard, C.B., M.B. |
| Sir F. H. Treherne, K.C.M.G., F.R.C.S. Edin. | F. R. Newland, C.M.G., M.B. |
| W. W. Pike, C.M.G., D.S.O., F.R.C.S.I. | J. J. Russell, C.B., M.B. |
| H. N. Thompson, C.B., C.M.G., D.S.O., M.B. | |

The undermentioned Colonels (Temporary Surgeon-Generals) to be Temporary Major-Generals, with effect from the date of their appointments as Temporary Surgeon-Generals:—

- | | |
|---------------------------------------|--------------------------------|
| O. R. A. Julian, C.B., C.M.G. | A. P. Blenkinsop, C.B., C.M.G. |
| M. P. C. Holt, K.C.M.G., C.B., D.S.O. | |

The undermentioned Temporary Surgeon-Generals to be Temporary Major-Generals whilst employed as Surgeon-Generals, with effect from the date of their appointments as Temporary Surgeon-Generals:—

- | | |
|--|--|
| Sir G. H. Makins, G.C.M.G., C.B., F.R.C.S. | C. S. Wallace, C.M.G., F.R.C.S. |
| Sir A. A. Bowlby, K.C.M.G., K.C.V.O., F.R.C.S. | Sir B. Moynihan, Kt., C.B., M.B., F.R.C.S. |

The undermentioned Temporary Surgeon-Generals to be Temporary Major-Generals whilst employed as Physician-Generals, with effect from the date of their appointments as Temporary Surgeon-Generals:—

- | | |
|--|--|
| Sir W. P. Herringham, Kt., C.B., M.D. | Sir B. E. Dawson, G.C.V.O., C.B., M.D. |
| Sir J. R. Bradford, K.C.M.G., C.B., M.D. | |

Surg.-Gen. (ranking as Lieut.-Gen.) Sir A. Keogh, G.C.B., M.D., F.R.C.P., retired pay, Acting Director-General, Army Medical Service, to be Lieutenant-General on the retired list, dated January 1, 1905.

Surg.-Gen. (temporarily ranking as Lieut.-Gen.) T. J. O'Donnell, C.B., D.S.O., retired pay, to be Major-General on the retired list, February 18, 1915, and to be Temporary Lieutenant-General whilst employed as Director of Medical Services in India, dated September 21, 1916.

Surg.-Gen. Sir W. Donovan, K.C.B., retired pay, a Director of Medical Services, to be Major-General on the retired list, dated December 2, 1904.

Surg.-Gen. Sir W. G. Macpherson, K.C.M.G., C.B., M.B., retired pay, a Deputy Director-General, Medical Services, to be Major-General on the retired list, dated July 14, 1914.

Col. (Hon. and Temp. Surg.-Gen.) Sir J. M. Irwin, K.C.M.G., C.B., M.B., retired pay, to be Temporary Major-General whilst employed as a Director of Medical Services, dated April 1, 1916.
Col. (Hon. and Temp. Surg.-Gen.) B. M. Skinner, C.M.G., M.V.O., retired pay, to be Temporary Major-General whilst employed as a Director of Medical Services, dated November 1, 1916.

Col. (Hon. and Temp. Surg.-Gen.) S. Hickson, C.B., M.B., retired pay, to be Temporary Major-General whilst specially employed.

Lieut.-Col. D. D. Shanahan, D.S.O., from Royal Army Medical Corps, to be Colonel, dated December 26, 1917.

Col. Edward George Browne, C.B., to be Temporary Surgeon-General, dated February 21, 1918.

The undermentioned relinquish the temporary rank of Colonel on re-posting :—

Dated December 10, 1917.—Lieut.-Col. Francis J. Brakenridge, C.M.G.

Dated January 16, 1918.—Brevet-Col. Frederick Smith, C.B., C.M.G., D.S.O.

Lieut.-Col. Frederick S. Penny, C.M.G., M.B., to be Temporary Colonel whilst employed as Assistant Director of Medical Services of a Division, dated December 11, 1917.

Capt. V. C. Honeybourne to be Temporary Major whilst in command of a Field Ambulance, dated December 13, 1915. (Substituted for the notification in the *Gazette* of April 18, 1916.)

The undermentioned Lieutenants (Temporary Captains) to be Captains :—

Dated February 28, 1918.—John C. A. Dowse, M.C., M.B.; Cedric O. Shackleton, M.B.; Frank P. Freeman, M.C.

Major Sir E. Worthington, Knt., C.M.G., M.V.O., Royal Army Medical Corps, from a Deputy Assistant Director-General, to be an Assistant Director-General, and to be Temporary Lieutenant-Colonel, dated March 1, 1918.

Major P. G. Easton, D.S.O., Royal Army Medical Corps, to be a Deputy Assistant Director-General, vice Major Sir E. Worthington, C.M.G., dated March 1, 1918.

Major A. B. Smallman, D.S.O., Royal Army Medical Corps, to be a Deputy Assistant Director-General, vice Major G. A. D. Harvey, who has vacated, dated March 1, 1918.

Capt. Alan C. Vidal, D.S.O., Royal Army Medical Corps, to be Major, dated February 28, 1918.

Major Frederick E. Rowan-Robinson, M.B., relinquishes the acting rank of Lieutenant-Colonel on re-posting, dated December 27, 1917.

The undermentioned Captains to be Acting Lieutenant-Colonels whilst in command of a Medical Unit :—

Dated December 16, 1917.—Robert B. Price, M.B.

Dated January 10, 1918.—Ivor R. Hudleston.

The undermentioned Captains to be Temporary Majors whilst in command of Field Ambulances :—

Dated August 16, 1915.—Gerald H. Stevenson, M.B.; Percy S. Tomlinson; Benjamin Johnson, M.B. (Substituted for the notification in the *Gazette* of October 13, 1916.)

PROCEEDINGS OF THE ROYAL ARMY MEDICAL CORPS' FUND COMMITTEE.

PARAGRAPH 14 OF THE PROCEEDINGS OF COMMITTEE, ROYAL ARMY MEDICAL CORPS' FUND, HELD AT ADASTRAL HOUSE, WAR OFFICE, ON FEBRUARY 27, 1918.

It was brought to notice that no decision had ever been made as to the number of members requisite to form a quorum at meetings of the Committee, and it was decided that in future the minimum number of members present necessary to transact business should be three (3).

NOTICE.

ROYAL ARMY MEDICAL CORPS FUND, REGULAR ARMY.
ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY, REGULAR ARMY.

THE Annual General Meeting of the Royal Army Medical Corps Fund will be held in the Library of the Royal Army Medical Corps College, Grosvenor Road, S.W., at 2.30 p.m., on Monday, June 10, 1918.

The Director-General will preside.

It is hoped that all subscribers who can spare the time will be present and will freely express their views on any point connected with the Fund.

The Annual General Meeting of the Royal Army Medical Corps Benevolent Society will take place immediately afterwards.

Any Officers desiring information regarding these Funds are requested to communicate with the Secretary beforehand so that there may be no delay in dealing with any questions asked.

124, Victoria Street, S.W.

F. M. WILSON,
Lieutenant-Colonel,
Secretary.

THE ROYAL ARMY MEDICAL CORPS.

BAND ACCOUNT.

RECEIPTS.

1917.	£	s.	d.	£	s.	d.
September 19. Balances brought forward..	205	16	6	5	15	1
October 9. Manager Central Pier Band Performances on Central Pier, September, 1917 ..	40	0	0	74	0	0
" 10. Bank Co., Cash ..	..	..	..	10	0	0
November 15. Bank, Cash ..	..	..	..	..	..	..
December 20. Cash Account, wrongly shown as Cash ..	0	10	0	..	..	..

	EXPENDITURE.	£	s.	d.	£	s.	d.
September 28. Messrs. Hawkes and Son, Music, etc.	12	0	8	..	..	..
October 4. Band President, Expenses on proceeding to London	2	0	0
" 9. Mr. Bradley, Bandmaster, Band Fees	74	9	0	..	..	..
" 10. Bandmaster and Bandman, Band Fees	74	9	0
" 9. Mr. Bradley, Salary	10	0	0	..	..	..
" 9. Serjt. Smith, Salary	1	10	0	..	..	..
" 9. Serjt. Smith, Incidental Expenses as per List	1	19	3
November 15. Mr. Bradley, Salary	10	0	0	..	..	..
" 15. Serjt. Smith, Salary	1	10	0	..	..	..
" 15. Self, Cash	10	0	0	..	..	..
" 15. Mr. Bradley, Incidental Expenses as per List	2	0	11
December 20. Mr. Bradley, Salary November and December	20	0	0	..	..	..
" 20. Serjt. Smith, Salary November and December	3	2	0	..	..	..
" 20. Mr. Bradley, Incidental Expenses as per List	4	9	0
Bank Account, wrongly shown as Cash per Contra-entry	0	10	0
Balances	103	14	10	4	15	11
		£246	6	6	£90	4	1

Audited and found correct,
 (Signed) J. FAIRBAIRN, Major, R.A.M.C., President.
 H. N. SEALY, Captain, R.A.M.C., } Members.
 H. J. C. GIBSON, Captain, R.A.M.C. }

£246 6 6 £90 4 1

BIRTHS.

HUGHES.—On March 6, at Leek Wootton, Warwick, the wife of Lieut.-Col. G. W. G. Hughes, D.S.O., R.A.M.C., of a son.

McCREERY.—On March 15, 1918, at 3, The Esplanade, Dover, the wife of Capt. (local Major) A. T. J. McCreery, M.C., D.A.D.M.S., Embarkation, of a daughter.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

NUMBER OF REPRINTS	NUMBER OF PAGES	COST OF REPRINTS	COST OF EXCERPTS *	EXTRA FOR COVERS FOR REPRINTS			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2	4 3	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. net; binding, 2s.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C.

The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Lieutenant-Colonels G. B. Edwards, W. I. Thompson; Majors A. S. Gordon Bell, Major A. W. Falconer; Captains J. H. M. Frobisher, H. W. Spaight, Miss I. M. Harmer.

The following publications have been received:—

British: Proceedings of the Royal Society of Medicine, Tropical Diseases Bulletin, Public Health, Journal of the Royal United Service Institution, The Journal of Tropical Medicine and Hygiene, The Medical Journal of Australia, The Royal Engineers' Journal, The Practitioner, Journal of the United Service Institution of India, The Medical Press and Circular, Publications of the South African Institution for Medical Research, St. Bartholomew's Hospital Journal, The Hospital, The Indian Medical Gazette, Edinburgh Medical Journal, Guy's Hospital Gazette, The Medical Review, The Army Service Corps Journal, The Indian Journal of Medical Research, Bulletin of Entomological Research.

Foreign: United States Public Health Service, Bulletin de l'Institut Pasteur, Colonies et Marine, Archives Médicales Belges, Bulletin de la Société de Pathologie exotique, Bulletin of the Johns Hopkins Hospital, Office International d'Hygiène Publique, Giornale di Medicina Militare, Norsk Tidsskrift for Militærmedicin, l'Ospedale Maggiore, Le Caducée, The Journal of Infectious Diseases, Zeitschrift für Militärärzte, Herausgegeben vom Sanität Corps.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,

"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"

25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C.4.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

APRIL, 1918.

War Office,
March 7, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated October 18, 1917, the following are the statements of service for which the decorations were conferred:—

AWARDED A BAR TO THE MILITARY CROSS.

Temp. Capt. Oswald John Day, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in leading his bearers through enemy barrages. He organized stretcher-bearers and effected the recovery of many wounded from close to the enemy's lines. (M.C. gazetted June 18, 1917.)

Temp. Capt. Archibald Fullerton, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in dressing and evacuating thirty cases of another division and over fifty of his own battalion under most adverse conditions. His medical orderly was killed, leaving him single-handed, and one shell killed and wounded twelve of his stretcher-bearers. (M.C. gazetted January 1, 1917.)

Temp. Capt. Noel John Hay Gavin, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked unceasingly for many hours at night dressing the wounded. When the Medical Officer sent to assist him was killed and the aid post was wrecked by shell fire, he continued his work of tending the wounded in the trenches and the open until relieved, although slightly wounded. He carried out his duties regardless of personal danger. (M.C. gazetted June 4, 1917.)

Temp. Capt. Arthur John Rushton O'Brien, M.C., M.B., African Medical Service.

For conspicuous gallantry and devotion to duty in action. He repeatedly dressed the wounded under heavy artillery and machine-gun fire in the open, bringing out about 150 wounded with stretcher parties, until he himself was dangerously wounded whilst performing his duties close to the firing line. (M.C. gazetted February 18, 1917.)

Temp. Capt. David James Sheiress Stephen, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in making a most daring reconnaissance in search of an aid post. Under very heavy fire he made arrangements for the removal of the wounded and bringing up medical supplies. On another occasion he took over the evacuation of the wounded and reorganized the system of evacuation, displaying cool judgment and contempt of danger in searching for the wounded. He set a fine example to his men. (M.C. gazetted July 24, 1915.)

AWARDED THE MILITARY CROSS.

Capt. John Alston, Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty when in charge of stretcher-bearers. He worked unceasingly for fifty-four hours, during the whole of which time he was under heavy shell fire, evacuating the wounded and clearing the field with great rapidity and skill. He declined to be relieved until he had seen the work through, setting a splendid example of cheerfulness and courage to all who were working with him.

Capt. Robert Ringrove Gelston Atkins, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. For seventy-two hours he worked continuously with his stretcher squads under very heavy artillery fire. He worked throughout a whole night between the various regimental aid posts and the advanced dressing station, organizing the evacuation of a large number of stretcher cases. He set a splendid example to all under him.

Temp. Capt. Philippe Bernard Belanger, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He moved about in the open, often having to jump from shell-hole to shell-hole, tending the wounded, regardless of the continuous machine-gun and shell fire. He was entirely responsible for the bringing in of many wounded men and thereby saving their lives. He did not desist until he had the whole battalion sector cleared of wounded, and throughout he set a magnificent example to the stretcher-bearers who followed him.

Capt. William Somerset Birch, Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. For seventy-two hours he worked with the stretcher-bearers of his field ambulance and collected the wounded under continuous fire. By his cheerfulness and disregard of danger he set a splendid example to all his bearers.

Temp. Capt. Archibald Grainger Bisset, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During heavy shelling of his battalion, when it was impossible to establish a dressing station, he went up and down the line himself attending to the men as they fell. Whenever a shell burst in the vicinity he at once hastened to the spot and did not leave the shelled area after his battalion had moved off until every case had been evacuated. He has shown the greatest gallantry and coolness at all times, notably on one occasion when, although badly gassed and unable to stand, he continued to attend to the wounded until he collapsed.

Capt. Arthur Bloom, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Several casualties were caused by shell fire at a battery position. He at once went 300 yards through a heavy barrage to the position, being blown up by an exploding shell on the way. He immediately attended to two wounded men, and then, while the battery was still being shelled, went round the position and attended to other wounded men. He displayed great courage, and his prompt action was one of very great value.

Temp. Capt. Oswald Vincent Burrows, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. For forty hours he worked unceasingly succouring the wounded, about 300 of whom passed through his hands during that period.

Temp. Capt. Charles Kingsley Carroll, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He carried on his work during an attack in one of the most exposed situations regardless of his own safety. His energy and devotion to duty saved many lives.

Temp. Capt. John Percival Charles, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked untiringly evacuating the wounded during the attack, continually dressing the wounded in shell-holes under very heavy fire until he was wounded. He set a magnificent example of fearlessness and devotion to duty.

Temp. Capt. Andrew Tocher Cunningham, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during a raid on the enemy's lines. He worked continually throughout an intense bombardment, attending to the wounded at the aid post until they had all been attended to and evacuated. He showed great courage and devotion to duty.

Temp. Capt. Lionel Montrose Dawson, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. While acting as officer in charge of bearers, he searched and cleared the line during the advance and during a counter-attack. He kept the regimental aid posts clear under trying circumstances, frequently going through a hostile barrage. He remained at his post for twenty-four hours without rest under very heavy fire.

Temp. Capt. Harold John de Brent, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He went about in a most fearless manner under heavy shell and machine-gun fire, collecting the wounded, dressing them in the open, and cheering them up. He remained in the most advanced position, almost surrounded by the enemy, until he had succeeded in attending to and clearing all the wounded. He took on the work of two other medical officers who were wounded, and remained at his post for a further five days. His conduct was magnificent throughout.

Temp. Capt. Carl Keating Graeme Dick, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He rescued three men from a dug-out which had been blown in and brought them to his aid post. His aid post was under shell fire.

but he went on working; and when his aid post was full he continued work outside utterly regardless of his own safety. It was largely owing to his gallant conduct that so many wounded were safely evacuated.

Temp. Capt. James Dickson, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty at his aid post when a shell exploded in the doorway, killing and wounding fourteen persons in the room where he was. Although very badly shaken, he continued his work until relieved twenty-four hours later.

Lieut. Louis du Vergé, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an action. He constantly dressed the wounded in the open under heavy shell fire, and showed complete disregard for his own safety.

Temp. Capt. Henry Hawes Elliot, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during several days' operations. He was out under very heavy fire finding wounded men, attending to them, and helping them back to the aid post, and, though wounded, continued at duty. When his aid post received several direct hits, he succeeded in evacuating all the wounded to a safer position. He set a fine example to his stretcher-bearers.

Temp. Capt. Henry Vincent Forster, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during several days' operations. When a counter-attack seemed imminent, he rallied every available bearer under heavy fire and evacuated all the wounded through a heavy barrage. He set a magnificent example to all.

Temp. Capt. Cosmo William Fowler, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked throughout the day during an attack, showing complete disregard of danger. On two occasions he went out in front of the line and brought in wounded who would otherwise have fallen into the hands of the enemy.

Temp. Capt. James Harcourt Cecil Gatchell, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked with great zeal for many hours in the open under heavy shell fire. He frequently dressed wounded men on the spot where they were hit, and when he was wounded he refused to leave his post until ordered to do so by his commanding officer. His contempt of danger and devotion to duty were an example to all ranks.

Temp. Lieut. John Alan Campbell Greene, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When an advance dressing station was shelled with 8-inch shells, he at once went to the spot and began to dig out men who were buried. Though the shelling continued, he did not desist until satisfied that the men were dead. He then assisted in clearing the entrance to the dressing station and attended to the wounded within. He showed an entire disregard of personal safety in his efforts to save life.

Capt. David Alexander Ross Haddon, M.B., Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry and devotion to duty. The dressing station was very heavily shelled, and he immediately ran to the centre of it, where he attended to all the wounded, and assisted in the evacuation of stretcher cases. He carried out operations in a hut which was continually under shell fire. He set a magnificent example to all.

Capt. John Livingston Hamilton, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in command of a stretcher-bearer sub-division during a raid on the enemy's lines. During an intense bombardment, and when he himself was twice wounded, he continued to dress the wounded throughout the night until they had all been evacuated. He set a magnificent example throughout the action.

Temp. Capt. David Cochrane Hanson, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Regardless of all danger, he attended to the wounded in the open under the heaviest shell fire, and, though knocked over several times by the explosion of shells, he continued to direct the work, and succeeded in getting the wounded out of the barrage zone. His gallant conduct was undoubtedly the means of saving many lives.

Temp. Capt. Arthur Randell Jackson, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was ceaseless in his efforts to get in casualties, repeatedly going forward through enemy barrages to the advanced posts. He worked in the open throughout the day, and set a splendid example to his stretcher-bearers.

Capt. Charles Llewellyn Lander, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked at an advanced dressing station on the line of the enemy barrage, and afterwards passed through the barrage to another dressing station, where he worked for a day and a half under continuous shell fire. He showed great courage and disregard of danger.

Capt. Harold Dunmore Lane, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During a daylight raid on the enemy's trenches he established his aid post in front-line trench, and worked there for many hours under

heavy artillery fire. He attended to the seriously wounded cases in the open, and was instrumental in bringing in all the wounded from No Man's Land and getting them successfully away.

Capt. Peter MacCallum, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He was in charge of the evacuation of the wounded from an advanced position, and worked in the open under very heavy fire for four successive days and nights, organizing stretcher squads and directing the removal of the wounded. He was the means of finding several severely wounded men lying in shell-holes and bringing them to safety under heavy fire. His splendid example and utter disregard of danger were largely responsible for the success of the evacuation.

Temp. Capt. Donald John Macdougall, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During the seventy hours the battalion was in the line he displayed great courage and fearlessness, dealing with a large number of wounded without assistance when all his orderlies had become casualties and his stores had been destroyed by shell fire.

Capt. Albert Edward Peel McConnell, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of the evacuation of the wounded. Though heavily shelled he kept his line perfectly clear. He superintended the evacuation personally, working for forty-five hours without ceasing under the most difficult and dangerous conditions, and by his example encouraged the men under him in every possible way. Later, he took two stretcher squads to the relief of batteries which were being heavily shelled.

Temp. Capt. Douglas Charles Murray Page, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in going through a heavy barrage in search of two wounded officers, about 500 yards across the open. He dressed their wounds in the open by the light of the gun flashes. Hearing that the Medical Officer of the relieving unit had been wounded, he obtained permission to remain with the incoming unit.

Capt. William Barry Postlethwaite, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He set a splendid example of untiring energy and contempt of danger to his stretcher-bearers throughout the operations, repeatedly leaving his aid post under heavy fire to attend to the wounded. He organized bearer-parties and went forward with them into No Man's Land and brought in a large number of wounded.

Capt. James Wilfrid George Hewat Riddel, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. While the battalion was assembling for the attack he attended to a large number of wounded on the spot. He was shelled out of his aid post, but during the whole of the day of the attack he attended to the wounded under heavy fire, and at night, when all the cases at the aid post had been attended to, he went out and dressed cases in No Man's Land, and guided stretcher parties to the wounded lying out in front.

Temp. Capt. William Russell, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When his Regimental Aid Post was blown in and most of the personnel and wounded killed, he went up to it through a heavy barrage and succeeded in evacuating all the survivors. On six occasions during the day he guided parties of bearers and brought back wounded, always in the open under heavy fire.

Capt. James Bethune Scott, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. A camp was heavily shelled and many casualties were caused. He showed great gallantry in going to the assistance of the wounded on three separate occasions in spite of heavy fire. By his coolness he not only saved many lives but gave great confidence and encouragement to the men around him.

Temp. Capt. Edward Segulier Sowerby, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in guiding parties of bearers and bringing back wounded in the open over most difficult ground and under heavy fire. On one occasion he led a party through a heavy barrage and succeeded in collecting many wounded from close to the enemy's line.

Temp. Capt. William Turner, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He had on two occasions to change his regimental post on account of its being destroyed by shell fire, but continued to dress the wounded of three battalions throughout the day in the open under heavy fire.

Lieut. Samuel Vidot, Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He carried on his work continually under heavy shell fire throughout the operation, and stayed behind after the battalion was relieved to attend to the wounded. He had previously entered a dug-out which was full of fumes and rescued a wounded officer.

Temp. Capt. John Alexandra Vlasto, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He attended to over one hundred cases

of wounded under extremely heavy shell and rifle fire. During a gas and smoke cloud he worked ceaselessly in the firing line, attending to men gassed and wounded. His courage and total disregard for his personal safety were a splendid example to all around him, and were the means of saving many lives.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
March 8, 1918.

The King has been graciously pleased to give directions for the following appointment to the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with Military Operations in the Field. To be dated January 1, 1918.

To be an Additional Member of the Third Class, or Companion of the said Most Distinguished Order:—

Lieut.-Col. (Temp. Col.) Henry Nason Dunn, D.S.O., M.B., Royal Army Medical Corps.

• • War Office,
March 8, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned Honour and Reward for valuable services rendered in connexion with the War. Dated January 1, 1918.

TO BE BREVET LIEUTENANT-COLONEL.

Major E. S. Forde, L.R.C.P., L.R.C.S., Royal Army Medical Corps.

War Office,
March 8, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned Reward for Distinguished Service in the Field. Dated January 1, 1918.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Major (Acting Lieut.-Col.) Henry Fulton, Royal Army Medical Corps.

War Office,
March 11, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for Distinguished Services rendered during the course of the campaign. His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question:—

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.

Croix de Guerre.

Lieut.-Col. (Temp. Col.) John Donald Alexander, D.S.O., M.B., Royal Army Medical Corps.
Lieut.-Col. Arthur Chopping, C.M.G., Royal Army Medical Corps.
Temp. Capt. Myer Coplans, D.S.O., M.D., Royal Army Medical Corps.
Capt. Thomas Frederick Corkill, M.B., Royal Army Medical Corps (Special Reserve).
Brevet Col. Stevenson Lyle Cummins, C.M.G., M.D., Royal Army Medical Corps.
Col. Samuel Guise Moores, C.B., C.M.G.
Temp. Capt. John Henry Herbert Pearson, M.D., Royal Army Medical Corps.
Surg.-Gen. Robert Porter, C.B., M.B.
Surg.-Gen. Sir Arthur Thomas Sloggett, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., K.H.S.
Major Herman Stedman, F.R.C.S., L.R.C.P., late Royal Army Medical Corps.

COMMUNIQUÉ.

N.B.—This list of mentions is for publication in the Press only, and will not be gazetted.

War Office,
March 13, 1918.

The names of the undermentioned have been brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the War, and when applicable an entry will be made in the records of service of Officers and other ranks:—

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. R. M. Beaton.
 Temp. Major O. Challis.
 Temp. Capt. O. C. M. Davis, M.B.
 Temp. Major J. A. Devine, M.D., D.S.O.
 Temp. Capt. W. V. Eaves, M.D.
 Capt. (Acting Major) H. F. Everett (Territorial Force).
 Major F. G. Faichnie.
 Temp. Capt. W. T. Finlayson.
 Capt. A. G. R. Foulerton.
 Capt. C. C. Frye, F.I.C. (Territorial Force).
 Lieut. Col. J. B. Gibbons, late Indian Medical Service.
 Lieut. (Temp. Capt.) W. Gilliatt (Territorial Force).
 Major A. M. H. Gray (Territorial Force).
 Temp. Major W. D. Home, M.D.
 Temp. Capt. S. Infield.
 Qmr. and Hon. Lieut. T. Jones (Territorial Force).
 Temp. Capt. J. Keenan, F.R.C.S.I.
 Temp. Major T. M. Kendall.

Lieut. (Temp. Capt.) J. P. Kinloch, M.D. (Territorial Force).
 Capt. and Brevet-Major R. W. D. Leslie.
 Major H. H. Littlejohn, M.D., F.R.C.S. Edin. (Territorial Force).
 Temp. Capt. G. Marshall, M.B.
 Major G. H. Rees, M.B.
 Temp. Major A. W. Robertson.
 Qmr. and Hon. Lieut. W. E. Squire.
 Capt. J. B. Stevenson, M.C., M.B.
 Temp. Lieut. R. Taylor, M.B.
 Qmr. and Hon. Lieut. W. Tuson.
 Major F. C. Whitmore (Territorial Force).
 Qmr. and Hon. Lieut. J. W. Willsher.
 Temp. Capt. D. Wilson, M.B.
 Major Sir E. S. Worthington, C.M.G., M.V.O.
 Temp. Major (Acting Lieut.-Col.) W. P. Yette.
 No. 26813 Staff-Serjt. F. Wills.

Lieut.-Col. C. Milne, M.B., Indian Medical Service.

Mauritius.

Lieut.-Col. D. Lawson.

Gibraltar.

Lieut.-Col. G. Dansey-Browning.
 Temp. Capt. E. V. Hunter.

Temp. Capt. (Local Major) C. G. H. Moore.
 Qmr. and Hon. Capt. W. T. Spencer.

Jamaica.

Lieut.-Col. J. H. A. Rhodes.

No. 2242 Cpl. J. Thompson.

Jersey.

Temp. Major (Surg.-Gen., Royal Jersey Militia) A. C. Stamberg, M.D.

Malta.

Capt. (Temp. Local Major) J. A. Arkwright.
 Capt. (Local Major) G. R. Bruce, Special Reserve.
 Major J. C. G. Carmichael.
 Major (Local Lieut.-Col.) C. H. Carr.
 Temp. Major G. Graham.
 Temp. Capt. G. Hamilton.
 Temp. Major T. Mackenzie.
 Qmr. and Hon. Capt. E. W. Newland.
 Capt. (Temp. Local Major) C. R. Nicholson.
 Major (Temp. Local Lieut.-Col.) A. C. O'Sullivan.
 Capt. A. Patrick.
 Capt. (Temp. Local Major) H. J. Pickering.
 Capt. (Temp. Local Major) C. H. G. Prance.
 Capt. (Temp. Local Major) A. B. W. Rust.
 Capt. (Temp. Local Major) H. H. Serpell.
 Temp. Capt. (Local Major) E. G. B. Starkie.
 No. 50225 Pte. (Acting Cpl.) H. Ackroyd.
 No. 14461 Serjt.-Major A. Baker.

No. 26 Serjt. (Acting Qmr.-Serjt.) F. Bax.
 No. 58577 Staff-Serjt. (Acting Serjt.-Major) W. A. Browne.
 No. 15671 Qmr.-Serjt. (Acting Qmr.) R. W. Cole.
 No. 50965 Pte. A. Davis.
 No. 5171 Serjt. (Acting Serjt.-Major) W. E. L. Eason.
 No. 18613 Serjt.-Major C. F. Grant.
 No. 44987 Serjt. (Acting Qmr.) J. W. Griffiths.
 No. 15813 Qmr.-Serjt. (Acting Serjt.-Major) A. V. Heggie.
 No. 19867 Pte. (Acting Serjt.) W. H. Hughes.
 No. 53243 Serjt. (Acting Serjt.-Major) W. King.
 No. 12058 Serjt.-Major A. W. Pettley.
 No. 44071 Serjt. (Acting Serjt.-Major) H. J. Randall.
 No. 52898 Pte. (Acting Serjt.) T. A. Scott.
 No. 43181 Pte. (Acting Serjt.) A. A. Smith.
 No. 12582 Serjt.-Major J. Whiting.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers and Men:—

No. 66354 Pte. (Acting Serj.) H. W. Dutton, M.M., Royal Army Medical Corps (Coventry). (M.M. gazetted February 1917.)

No. 337246 Serjt. (Acting Company Serjt.-Major) W. Miller, M.M., Royal Army Medical Corps (Liverpool). (M.M. gazetted March 12, 1917.)

No. 47455 Pte. H. G. Fulljames, M.M., Royal Army Medical Corps (Camberwell). (M.M. gazetted June 18, 1917.)

No. 301239 Pte. G. Cruickshank, M.M., Royal Army Medical Corps (Aberdeen). (M.M. gazetted July 18, 1917.)

No. 510220 Pte. J. N. Hawken, M.M., Royal Army Medical Corps (St. George's Square). (M.M. gazetted November 2, 1917.)

No. 341318 Serjt. T. R. Jackson, M.M., Royal Army Medical Corps (St. Helens). (M.M. gazetted January 14, 1918.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 89018 Pte. E. Airey (East Gateshead).
 No. 326016 Pte. C. Allison (Glasgow).
 No. 45507 Pte. A. Ansell (Warlingham).
 No. 419459 Pte. G. W. Baker (Leicester).
 No. 538194 Pte. W. R. Baker (East Dulwich).
 No. 405142 Pte. S. Barker (Sheffield).
 No. 510480 Serjt. J. B. Barry (Chard).
 No. 90014 Pte. E. Bell (Luton).
 No. 47037 Qmr.-Serjt. (Acting Serjt.-Major) H. O. Bell (Belfast).
 No. 74767 Pte. W. E. Bennellick (Camborne).
 No. 512556 Pte. J. A. C. Bennett (Beckenham).
 No. 22667 Pte. L. Birkby (Bradford).
 No. 6474 Pte. E. C. Bishop (Liverpool).
 No. 33747 Pte. (Acting Serjt.) G. S. Blow (Walthamstow).
 No. 473453 Pte. F. S. Blows (Cherryinton).
 No. 538128 Pte. A. Boast (Huddersfield).
 No. 403165 Pte. W. H. Bourne (Castleford).
 No. 473168 Cpl. (Acting Lance-Serjt.) G. Brasnett (Manningtree).
 No. 512550 Pte. J. C. Buckley (Hornchurch).
 No. 74440 Pte. E. C. Callard (Exeter).
 No. 514070 Pte. E. Campion (St. John's Hill, S.W.).
 No. 419382 Pte. J. A. Cartwright (Leicester).
 No. 337605 Pte. J. Charles (Liverpool).
 No. 341493 Pte. S. Clarke (St. Helens).
 No. 41206 Lance-Cpl. S. J. Clarke (Belfast).
 No. 19731 Pte. A. Clements (Leytonstone).
 No. 47223 Pte. A. Clifton (East Bergholt).
 No. 508259 Pte. N. R. Cook (Rochford).
 No. 71908 Pte. J. Cowan (Kirkconnel).
 No. 459278 Pte. J. M. Craze (Camborne).
 No. 457400 Pte. F. A. Crispin (South Brent).
 No. 5313 Pte. A. W. Crowther (Shorncliffe).
 No. 341650 Pte. F. Cunningham (St. Helens).
 No. 337250 Pte. S. Davies (Liverpool).
 No. 512408 Pte. W. G. Dawson (Faversham).
 No. 536329 Pte. H. E. Deere (Cardiff).
 No. 473050 Pte. G. W. Dennant (Ipswich).
 No. 536439 Pte. A. Douglas (Drury Lane, W.C.).
 No. 337317 Pte. W. Duke (Liverpool).
 No. 16979 Serjt. (Acting Staff Serjt.) R. V. V. Egan (Hyde Park, W.).
 No. 55285 Serjt. R. Fallowfield (Strines).
 No. 53352 Pte. D. Farnan (Dunmurry).
 No. 67964 Pte. D. Fielder (Lower Swanwick).
 No. 25133 Pte. J. Fielding (Blackburn).
 No. 337527 Pte. R. A. Finch (Liverpool).
 No. 71655 Cpl. W. H. Folley (Maidenhead).
 No. 534100 Pte. N. Foord (Crayford).
 No. 9607 Cpl. J. Fowler (Blackburn).

No. 71816 Lance-Cpl. C. E. Francis (Liverpool).
 No. 534036 Serjt. H. Gibbs (Belvedere).
 No. 7892 Pte. T. H. Gibson (Manchester).
 No. 459246 Cpl. O. P. Gill (Camborne).
 No. 32209 Pte. W. Guthrie (Londonderry).
 No. 534043 Pte. M. Hallaway (Dartmouth).
 No. 510237 Pte. H. H. Hand (Newcastle-under-Lyme).
 No. 39891 Pte. H. J. Harding (Bolney).
 No. 47431 Pte. H. Heath (Walthamstow).
 No. 71954 Pte. H. Hewson (Luton).
 No. 403567 Lance-Cpl. J. Hillerby (Shipley).
 No. 76127 Pte. W. Holden (Accorington).
 No. 75076 Pte. J. H. Holdsworth (Pitmoor).
 No. 4712 Pte. W. C. Holloway (Manchester).
 No. 34680 Pte. (Acting Serjt.) G. E. Hughes (Liverpool).
 No. 337234 Pte. H. Jackson (Liverpool).
 No. 69566 Pte. W. Jackson (Manchester).
 No. 536442 Pte. H. James (Leighton Bussard).
 No. 316104 Pte. A. Junor (Glasgow).
 No. 69320 Pte. J. Kehoe (Newton-le-Willows).
 No. 419378 Pte. C. Kingston (Sutton Bridge).
 No. 51292 Pte. W. C. A. Laing (Peebles).
 No. 405088 Cpl. H. H. Lake (Sheffield).
 No. 9680 Pte. A. Larking (Thorpe Audlin).
 No. 75141 Pte. W. Laws (Willington).
 No. 48522 Pte. D. Lockray (Castle Douglas).
 No. 45453 Pte. J. Masters (Wimbledon).
 No. 459014 Serjt. A. W. Matthews (Plymouth).
 No. 408026 Pte. J. W. McCullough (Leeds).
 No. 316069 Pte. N. McMillan (Glasgow).
 No. 536411 Pte. J. W. Milton (Battersea).
 No. 41183 Pte. J. E. Mitchell (Belfast).
 No. 47040 Staff-Serjt. D. Moffatt (Baillieborough).
 No. 508067 Lance-Cpl. V. Mossman (Brixton).
 No. 64558 Pte. A. D. Murray (Croick, For-sinard).
 No. 75030 Pte. J. Newman (Darlaston).
 No. 512231 Lance-Serjt. (Acting Serjt.) P. Oakenfull (Westcliff-on-Sea).
 No. 401152 Pte. A. D. Odgers (Leeds).
 No. 538267 Pte. H. Parris (Wimbledon).
 No. 90698 Pte. F. G. Paul (Swindon).
 No. 403249 Pte. G. J. Peakman (Leeds).
 No. 339649 Pte. R. Peers (Liverpool).
 No. 46538 Pte. (Acting Cpl.) D. Philip (Glasgow).
 No. 3134 Pte. A. Pirie (Elgin).
 No. 536365 Serjt. W. H. L. Price (Sydenham).
 No. 39680 Serjt. E. A. Rees (Small Heath).
 No. 54889 Cpl. A. E. Reese (Clun).
 No. 538177 Pte. E. Rocker (Hanwell).

- No. 75014 Pte. A. Rogerson (Newcastle, Staffs).
 No. 6726 Cpl. (Acting Serjt.) W. S. Salter (Bickleigh).
 No. 54658 Pte. J. Savage (Oswaldtwistle).
 No. 508271 Pte. A. Schofield (Fulham).
 No. 512410 Lance-Cpl. J. H. Searle (Hassocks).
 No. 538101 Serjt. A. W. Shaw (Notting Hill).
 No. 47468 Pte. W. Short (Yoxford).
 No. 457034 Pte. H. Smith (Teignmouth).
 No. 73193 Pte. (Acting Lance-Cpl.) J. T. Smith (Newtown, Linford).
 No. 53120 Pte. R. W. Southard (Fulham).
 No. 461503 Pte. W. A. Spooner (Rotherhithe).
 No. 64670 Pte. (Acting Cpl.) J. H. Stewart (Pettigo, co. Galway).
 No. 54325 Pte. B. Strickland (Preston).
 No. 401160 Pte. G. D. Summerscales (Leeds).
 No. 11636 Pte. J. Supple (Clyduff).
 No. 301450 Pte. J. W. Sutherland (St. Helens).
 No. 3137 Pte. A. C. Swan (E. Glasgow).
 No. 538285 Lance-Cpl. H. Symons (Cambridge).
 No. 301173 Pte. W. W. Taylor (Aberdeen).
 No. 457189 Pte. A. W. Thackway (Bath).
 No. 3800 Pte. J. Thompson (Agher).
 No. 419313 Lance-Cpl. O. Thompson (Leicester).
 No. 538060 Serjt. T. H. Treadwell (Chelsea).
 No. 66583 Pte. A. B. Turner (Cheltenham).
 No. 18886 Pte. P. Walsh (Rochdale).
 No. 90005 Pte. W. Warren (Luton).
 No. 64481 Pte. (Acting Lance-Cpl.) A. J. Watts (Sapote).
 No. 512303 Lance-Cpl. H. D. Watts (Beckenham).
 No. 473305 Pte. H. T. Webb (Newmarket).
 No. 71968 Pte. (Acting Cpl.) P. G. Williams (Peckham).
 No. 508186 Pte. E. C. Willoughby (Cranley Gardens).
 No. 301334 Pte. H. Wilson (Aberdeen).
 No. 337351 Pte. R. Wilson (Larne).
 No. 64066 Pte. (Acting Cpl.) J. C. Wood (East Hebburn).
 No. 508372 Pte. H. P. Wright (Greenhithe).
 No. 403491 Pte. C. Yates (Bradford).

His Majesty the King has been graciously pleased to award the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, in recognition of valuable services rendered with the Armies in the Field during the present War:—

ROYAL ARMY MEDICAL CORPS.

- No. 60206 Pte. (Acting Lance-Serjt.) G. W. Beach (Uxbridge).
 No. 17749 Qmr.-Serjt. (Acting Serjt.-Major) J. Black (Oldham).
 No. 11236 Serjt. B. A. Embelin (Dublin).
 No. 5049 Pte. A. Kellett (Hunslet).
 No. 18656 Staff-Serjt. (Acting Serjt.-Major) H. G. Maywood (London, W.).
 No. 322005 Staff-Serjt. (Acting Qmr.-Serjt.) W. G. Patterson (Dysart, Fife).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.
 March 15, 1918.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire for services in connexion with the War in France, Egypt and Salonika. The appointments to date from January 1, 1918:—

To be Officer of the said Most Excellent Order:—

Lieut.-Col. Charles Edward Percy Fowler, Royal Army Medical Corps.

War Office,
 March 18, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated October 27, 1917, the following are the statements of services for which the decorations were conferred:—

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. John Caruthers Sale, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an attack. He collected the wounded over a large tract of country exposed to heavy fire, and continuously went out by night in advance of the front line searching for the wounded, many of whom he brought back over most difficult ground and under heavy fire. His coolness and determination were a splendid example to his stretcher-bearers.

AWARDED A BAR TO THE MILITARY CROSS.

Temp. Capt. Hugh Ross McIntyre, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When in charge of the evacuation of the wounded he from time to time led his stretcher-bearers and cleared the wounded, although exposed to fire from snipers. He worked untiringly and incessantly for three days without sleep, and it was due very greatly to his efforts that the regimental aid posts were kept clear of

wounded, and cases quickly evacuated to the advanced dressing station. He is fearless in the face of danger, and by his splendid courage and example he inspired confidence in his men.

AWARDED THE MILITARY CROSS.

Temp. Lieut. Henry Marston Layard Crawford, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He dressed and collected the wounded under heavy shell fire, and on the withdrawal he remained with the rearguard, still under heavy fire, collecting more wounded. By his pluck and determination he succeeded in bringing in all his wounded, though compelled to make a wide detour through exceptionally heavy and difficult country.

Temp. Qmr. and Hon. Lieut. Charles Elliot, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Whilst in charge of the arrangements for the evacuation of the wounded, he time after time took men out under heavy shell fire and repaired the line. He frequently volunteered to go forward and find out the position of wounded men lying out in the open. He worked incessantly for fifty hours without rest under fire, and showed a splendid example to others.

Temp. Capt. Leslie Haden Guest, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On the night of an attack he gallantly led his stretcher squads under heavy shell fire and collected wounded who were lying out on newly captured ground. By his courageous example and disregard of danger he was the means of saving many wounded men.

Temp. Capt. William Llewellyn Aplin Harrison, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established his aid post within 200 yards of the front line as soon as the objective had been reached and thereby saved many lives. Though his aid post was twice destroyed by shell fire he continued at work with complete disregard of danger, inspiring all who came in contact with him by his splendid example.

Temp. Capt. William George Johnston, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Whilst in command of the stretcher-bearers evacuating the wounded he worked under shell fire for fifty-five hours, leading his bearers time after time to collect wounded lying out in the open. On another occasion he went out under heavy shell fire and succeeded in getting out alive some men who had been buried in the forward trenches. His fearless conduct, disregard of personal danger and devotion to duty saved many valuable lives.

Temp. Capt. Robert Kennon, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During the recent operations this officer continued for three days to dress wounded, during which period he was continually under heavy shell fire, and his dressing station was blown in. With the greatest coolness and devotion to duty he continued his life-saving work, and was a splendid example to all ranks.

Temp. Capt. John Kirton, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an action. He went forward under shell fire to dress and collect wounded and help and encourage the stretcher-bearers at their duties, working for five consecutive days without rest. It was largely owing to his excellent work that the evacuation of the wounded of the division was successfully carried out, and by his efforts many wounded men were got into safety.

*Capt. John Joseph Harper Nelson, M.D., Indian Medical Service.

For conspicuous gallantry in action. He tended the wounded in the open for a long period, although exposed to heavy fire of all descriptions. He showed fearlessness throughout, and his example was of great value to all.

Temp. Capt. Wilfrid John Pearson, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When in charge of the evacuation of the wounded, he worked under heavy shell fire for fifty hours without rest, and it was largely due to his untiring efforts that the wounded in this sector were got away so quickly. On one occasion, when caught in the barrage of the enemy's heavy guns, and though severely shaken, he continued to work without intermission, his untiring labours being instrumental in saving many valuable lives.

Note.—Since the publication of these officers' names in the *Gazette* of October 27, 1917, promotion has, in some cases been conferred, and the ranks herein shown are not therefore in all cases those now held.

*The name marked thus has not previously appeared in the *Gazette*.

War Office,
March 22, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated November 19, 1917, the following are the statements of services for which the decorations were conferred :—

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. Gordon Wilson Armstrong, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked in the open under continuous and heavy shell fire and dressed and evacuated 117 stretcher cases from his aid post in twenty-

seven hours. Later on, while the shelling was very severe, he volunteered to go in aid of an officer and an orderly, carrying them to the aid post one after another on his back. Though wounded during the second journey he refused to leave his post, remaining with his battalion until it was relieved.

AWARDED A BAR TO THE MILITARY CROSS.

Capt. William McMeekin Chesney, M.C., M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty when in charge of stretcher-bearers. He continually visited the forward aid posts throughout the day and supervised the evacuation of the wounded under very heavy shell and machine-gun fire. Though wounded he refused to quit his post until he had rendered a valuable report on the evacuation of the wounded. He worked with indefatigable energy and great courage throughout.

Temp. Capt. Robert Welton Hogg, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty while in charge of a forward bearer post he worked indefatigably for three days, evacuating the wounded from the regiment aid posts in the line, moving about continuously under heavy enemy barrages. It was entirely due to his fine example and untiring energy that over 200 stretcher cases were safely got away from the front during the first six hours of the attack.

Temp. Capt. Hubert Francis Wilson, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established his regimental aid post in a shell hole close to the firing line, and maintained it in spite of heavy shell fire. During an attack he went forward under heavy fire and attended to the wounded, who could not be brought in by the stretcher-bearers. His devotion to duty and unceasing energy is deserving of the highest praise.

AWARDED THE MILITARY CROSS.

Capt. Bernard Gordon Beveridge, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of a divisional collecting post and relay bearer posts during an action, and organized and carried out the evacuation of the wounded over the open under continuous fire. It was only by his unfailing courage and energy that the work was successfully accomplished.

Temp. Capt. Dimock Stanley Cassidy, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When a party of men were gassed in a mine-shaft he went down and remained there all night preparing to render first-aid. He did not leave his post even when seriously affected by gas.

Capt. George Eustace, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was going forward with a party which came under a very heavy barrage. He remained out in the barrage attending to the wounded regardless of danger, and carried one wounded man several hundred yards through the barrage to safety.

Capt. Frederick George Harper, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked incessantly, attending to the wounded under heavy shell fire. He set a magnificent example to all, and undoubtedly saved many lives.

Temp. Capt. James Jack, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established forward collecting posts and dressed and removed the wounded with great coolness and disregard of danger during a period of four days and nights. Most of the time he was under heavy shell fire, and set a fine example of courage to his men.

Capt. Harold Howard Lesson, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed the utmost courage and total disregard for personal safety when commanding stretcher-bearer squads. His splendid example under heavy shell fire inspired those working under him.

Temp. Capt. Charles Fellowes MacLachlan, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously for forty-eight hours under heavy shell fire, attending to the wounded, much of his work being done in the open. His services were of the greatest value, and he set a magnificent example to all.

Temp. Capt. Peter Malcolm MacLachlan, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an attack. As soon as the battalion captured its objective he went to the front line under heavy shell fire to bring back the wounded. He did excellent work under heavy fire throughout the operations, and showed great gallantry and disregard of danger.

Capt. James Stewart McConnachie, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of a divisional collecting post during an attack, and organized and carried out the evacuation of the wounded under heavy fire, in the course of which his post was several times hit. He carried on his work during several counter-attacks by the enemy, and set a splendid example of coolness and courage.

Qmr. and Hon. Lieut. Francis Poole, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He remained at the advanced collecting station for several days organizing the rationing of the wounded, and daily visited the relay posts and regimental aid posts with supplies of medical comforts and dressings. During heavy shelling he helped to withdraw the wounded, and lives were saved by his action and example. He has continuously done excellent work.

Temp. Capt. Alexander Waugh Young, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked untiringly in attending to the wounded, continually going out into the most forward area under heavy machine-gun fire with his men, encouraging and directing them in their work. It was due to him that nearly 200 cases were evacuated from the line.

Note.—Since the publication of these Officers' names in the *Gazette* of November 19, 1917, promotion has, in some case, been conferred, and the ranks herein shown are not, therefore, in all cases those now held.

War Office,
March 25, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for Distinguished Services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the decorations and medals in question.

DECORATIONS AND MEDALS CONFERRED BY HIS MAJESTY THE KING OF ITALY.

Order of the Crown of Italy. Cavalier.

Temp. Major (Acting Lieut.-Col.) Ernest Frederick Eliot, F.R.C.S., Royal Army Medical Corps.

Temp. Capt. Reginald Hutchinson Lucas, M.C., Royal Army Medical Corps.

Order of the Crown of Italy. Silver Medal for Military Valour.

106120 Pte. Frank France, Royal Army Medical Corps (Bolton).

War Office,
March 26, 1918.

His Majesty the King has been pleased to confer the undermentioned rewards for Gallantry and Distinguished Service in the Field. The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable.

AWARDED THE MILITARY CROSS.

Royal Army Medical Corps.

Capt. Alan Colpitts Ainsley.

Temp. Capt. William Kenneth Bigger.

Capt. William Edward Hugh Bull.

Temp. Capt. Nicholas Marshall Cummins, M.B.

Capt. William Goldie, M.B.

Temp. Capt. Benjamin Knowles, M.B.

Capt. Percival John Moir, M.B.

Temp. Capt. Rex Stansfield.

Capt. Bryan Montague Tuke, Spec. Res.

Capt. Rankine Greig Walker, M.B.

Temp. Lieut. V. K. Apte, I.M.S.

Lieut. Glaude Wells Woolloton Baxter, I.M.S.

Capt. Charles Aubrey Godson, I.M.S.

Capt. Charles Newton Davies, M.B., I.M.S.

The following is the correct description of an Officer upon whom a reward has recently been conferred:—

Major (Temp. Lieut.-Col.) Charles Algernon Stidston, D.S.O., M.C., R.A.M.C. (D.S.O. gazetted February 4, 1918.)

War Office,
March 26, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for Distinguished Service in the Field. Dated January 1, 1918.

TO BE BREVET LIEUTENANT-COLONELS.

On Retired List, Reserve of Officers, Special Reserve, New Army or Territorial Force, in the case of Officers belonging to these categories, as applicable.

Major (Temp. Lieut.-Col.) R. M. Barrow, I.M.S.

Major (Temp. Lieut.-Col.) M. Mackelvie, M.B., F.R.C.S. Edin., I.M.S.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for Distinguished Service in the Field. Dated January 1, 1918.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Capt. J. Scott, M.B., I.M.S.

AWARDED THE MILITARY CROSS.

Capt. James Dunlop Kidd, M.D., Royal Army Medical Corps.

War Office, April 2, 1918.

His Majesty the King has been graciously pleased to approve of the award of the Military Medal to the undermentioned Men:—

No. 30825 Pte. C. Bull, Royal Army Medical Corps (Romford).

No. 101731 Pte. G. Glaze, Royal Army Medical Corps (Smallthorne).

No. 102037 Pte. A. C. Goodwin, Royal Army Medical Corps (Bollington).

War Office, April 4, 1918.

The following are among the decorations and medals awarded by the Allied Powers at various dates to the British Forces for Distinguished Services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the decorations and medals in question.

DECORATIONS CONFERRED BY H.H. THE SULTAN OF EGYPT.

Order of the Nile. 4th Class.

Captain William Edward Marshall, M.C., M.B., Royal Army Medical Corps.

Captain William Hubert Milligan, Royal Army Medical Corps.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

NOTICE.

THIS Fund provides annuities of £50 a year (together with any additional benefits which may be available from distribution of surplus, which at present, in the majority of cases amount to a bonus of £200 to the widow) to the widows of subscribers and to their children under 21 years of age. The annual subscription varies according to the ages of husband and wife: e.g., in the case of a husband aged 30, and wife aged 25, it would amount to £14 18s. 6d.; where husband and wife were both aged 28 it would be £12 19s. 11d.

The Committee have been able to reduce the extra war charge to one of 25 guineas per annum, in addition to the normal annual subscription according to scale. It has also been resolved that officers gazetted to permanent commissions in the Corps on January 1, 1917, and up to May 22, 1917, shall be eligible for membership on the above terms. The cases of those who may be gazetted later will be considered as they arise.

The Secretary will be glad to give any further information as to details.

3, Homefield Road,
Wimbledon, S.W.

J. T. CLAPHAM, Captain,
Secretary.

SUMMARY OF THE PROCEEDINGS OF A MEETING OF THE COMMITTEE WHICH WAS HELD AT THE ROYAL ARMY MEDICAL COLLEGE, ON MONDAY, APRIL 15, 1918.

Present:

Dep.-Surg.-Gen. W. G. Don, Vice President, in the Chair.

Surg.-Gen. W. S. M. Price, Vice-President.

Surg.-Gen. Sir H. R. Whitehead, K.C.B.

Lieut.-Col. J. More Reid.

Lieut.-Col. P. S. O'Reilly, C.M.G.

(1) Surg.-Gen. Sir H. R. Whitehead, K.C.B., took his seat on the Committee, under Rule XXVI.

(2) The minutes of the preceding Meeting were read and confirmed.

(3) The Accounts and Report for the year 1917 were examined and unanimously adopted.

(4) The date of the Annual General Meeting was fixed for Monday, May 20 (subsequently changed to May 13), in the Library of the Royal Army Medical College, at 3 o'clock.

(5) Lieut.-Col. G. B. Riddick was admitted a first-class married member at an annual subscription of £29 9s., together with an extra War charge of £26 5s. per annum; his membership to date from March 5.

(5a) The re-marriage of an annuitant, Mrs. N. Manders, was reported. The Secretary was authorized, under Rule XVII, to continue the annuity to her for the benefit of her daughter, until the latter attains the age of 21 years.

(6) Payment of annuities for the coming half-year to those on the list was sanctioned.

(7) The death was reported of Mr. H. D. Andras, F.I.A., Consulting Actuary to the Society. The Secretary was directed to forward to his widow a resolution expressing the sympathy of the Committee, and their high appreciation of the services rendered to the Society by Mr. Andras.

The question of the appointment of an Actuary in his place was considered; but it was not considered desirable to make one until after further inquiry.

(8) The Secretary reported that the half-yearly interest on £124,000 five per cent War stock, due on June 1 next, would amount to £3,100, the greater part of which should be available for investment. It was resolved that, subject to the advice of the Hon. Treasurer, Sir James McGrigor, Bt., and to the approval of the Trustees, the available cash surplus, up to a total of £3,000, be invested in five per cent National War Bonds.

(9) Should any officers, other than those already eligible for membership, be gazetted to permanent commissions in the Corps, before the date of the next meeting of the Committee, it was resolved that they be eligible for membership on the present terms, viz., at an extra War charge of 25 guineas per annum, in addition to the normal annual subscription according to scale.

(10) Payment of the audit fee for the past year to Messrs. Deloitte and Co. was sanctioned.

(11) Payment of the Secretary's salary for the past quarter was sanctioned, as also of office allowance and refund of petty cash.

3, Homefield Road,
Wimbledon, S.W.

J. T. CLAPHAM, *Captain,*
Secretary.

REPORT OF THE COMMITTEE OF MANAGEMENT TO THE MEMBERS OF THE ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND FOR THE YEAR ENDED DECEMBER 31, 1917.

The Committee beg to present the following Report on the affairs of the Society, and to submit the accounts for the year ended December 31, 1917.

During the past year the deaths of three married and one unmarried members have been reported, none of whom were on the Active List. Among them, deeply regretted, was Lieut.-Col. Alfred F. S. Clarke, who for many years took the keenest interest in the management of the Society, of which for some time he was one of the Trustees. One unmarried member, Lieut.-Col. W. M. Harman, has resigned; he had subscribed to the funds of the Society for fifty years. Two married members have joined; and there are three fresh annuitants, the bonus to one of whom, owing to delay in reporting, does not appear in the accounts. All of them are entitled to the gratuity on the higher scale of £200. Four annuitants have died during the year. The total number of members is now 165, of whom 10 are unmarried, and of annuitants 67.

The Committee much regret to record the death of the Consulting Actuary, Mr. H. W. Andras, F.I.A. Under his guidance the Society was re-organized in 1905. He took the greatest interest in its welfare, and much of its success in recent years is due to his expert advice. His loss will be much felt.

The number of casualties among officers of the Corps up to the end of 1916 having proved less than was expected, and the financial position of the Society being most satisfactory, the Committee, with the concurrence of the Actuary, were able in the spring of 1917 to reduce the extra war charge to new members from 50 guineas per annum to 25 guineas, and to make an equivalent refund to such members as had already paid the full charge. Officers whose permanent commissions date from January, 1917, were made eligible for membership at the above annual rate, and notices were sent to all of them stating the benefits provided by the Society. They numbered as gazetted 111, of whom five have been killed in 1917. So far only one has joined the Society, but the proportion of married men amongst them is not yet known.

As far as can be ascertained the deaths among regular officers on the Active List since the outbreak of war have been seventy. Of these there were killed in action, died of wounds, drowned or died as prisoners of war: In 1914, 22; in 1915, 11; in 1916, 6; in 1917, 13. As to the remaining eighteen, it is not known in what proportion death was directly or indirectly due to conditions of service. It must also be remembered that the effects of the War in an increased death-rate amongst members are likely to be seen in future years.

Considerable changes were made during the last year in the investments of the Society, but, as most of them occurred in the early part of the year, mention of such was made in the last Report. As, however, these changes are now shown in the accompanying Balance Sheet for the first time, it may be well to refer to them again.

For many years the greater part of the Society's funds had been on deposit with the National Debt Commissioners, for the most part at £3 16s. per cent per annum. The whole of the then balance, amounting with interest to £104,386 18s. 9d., was withdrawn in February, 1917, and invested in the 5 per cent War Loan 1927/47. That sum, together with conversions and surplus funds of the Society, amounting in all to £124,000, was invested as follows:—

By investment of £104,386 18s. 9d. as above	£109,880 19 8
" " £2,407 17s. 4d. cash surplus 1917	2,540 2 10
By conversion of £10,000 4½ per cent War Stock 1925/45	
and £1,000 5 per cent Exchequer Bonds, 1920	11,578 17 6

Total 5 per cent War Stock, 1929/47 £124,000 0 0

As the result of these Investments the income of the Society has been increased by £1,600 per annum.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

ACCOUNTS FOR THE YEAR 1917.

(In the form prescribed for the Annual Return of a Registered Friendly Society.)

(A) BENEFIT FUND.

DR.	INCOME.	£	s.	d.	EXPENDITURE.	CR.
						£ s. d.
Members' Subscriptions...	.. .. .	2,316	14	2	Widows' Annuities	3,282 19 9
Interest on Investments of Benefit Fund (including amounts recoverable in respect of Income Tax) ..	7,194 11 2				Bonuses to Widows	400 0 0
					Refund to Members of proportion of extra War Charges paid in 1915 and 1916	157 10 0
Total Income	£9,511 5 4				Interest on £5,868 7s. 10d. (balance of Management Fund at the end of the year 1916) at 3 per cent, transferred to Management Fund	176 1 0
Amount of Benefit Fund at the beginning of the year, as per last Balance Sheet	138,170 8 10				Total Expenditure	£4,016 10 9
					Amount of Benefit Fund at the end of the year, as per Balance Sheet (C)	143,665 3 5
						<u>£147,681 14 2</u>

(B) MANAGEMENT FUND.

DR.	INCOME.	£	s.	d.	EXPENDITURE.	CR.
						£ s. d.
Interest for one year on £5,868 7s. 10d. at 3 per cent, transferred from Benefit Fund	176 1 0				Secretary's Salary	160 0 0
Amount of Management Fund at the beginning of the year, as per last Balance Sheet	5,868 7 10				Actuary's Fee	10 10 0
					Auditors' Fee	10 10 0
					Office Allowance	60 0 0
					Printing, Postages, and Stationery	16 3 5
					Total Expenditure	£247 3 5
					Amount of Management Fund at the end of the year, as per Balance Sheet (C)	5,797 5 5
						<u>£6,044 8 10</u>

(C) BALANCE SHEET AT DECEMBER 31, 1917.

DR.		LIABILITIES.		ASSETS.		OR.	
Benefit Fund, as per Account (A)		Management Fund, as per Account (B)		INVESTMENTS.		Rate per cent of Interest yielded	
Sundry Liabilities—		(from October 1 to December 31, 1917)		(1) In the Public Funds—		£ s. d.	
Secretary's Salary	£124,000 0 0	War Stock, Five per Cent, 1929-1947 ..	5 5 6	117,507 6 1
Actuary's Fee	3,000 0 0	National War Bonds, Five per Cent, 1927 ..	5 0 0	3,000 0 0
Office Allowance	5,500 0 0	Dominion of Canada Three and a Half per Cent— Stock, 1930-1950 (lent to H.M. Treasury at an additional Half per Cent)	5 11 1	3,958 5 8
Annuities outstanding	2,000 0 0	Newfoundland Three and a Half per Cent Stock, 1950 ..	4 16 1	1,456 17 6
					(2) Upon the Security of Borough and County Rates, or other Corporate Funds—		
					5,000 0 0	London County Council Three and a Half per Cent Stock	4 9 10
					5,000 0 0	Metropolitan Water Board "B" Three per Cent Stock ..	4 12 1
							3,259 7 6
					(3) Other Securities—		
					5,000 0 0	Great Western Railway Four per Cent Debenture Stock ..	4 15 2
					5,000 0 0	London and North Western Railway Three per Cent Debenture Stock ..	4 13 4
					1,500 0 0	Caledonian Railway Four per Cent Debenture Stock ..	4 13 4
					7,900 0 0	Midland Railway Two and a Half per Cent. Debenture Stock ..	4 15 8
					2,100 0 0	East Indian Railway Three and a Half per Cent Debenture Stock ..	4 17 7
							1,506 15 0
					NOTE—A Valuation of the above Securities at middle published prices on December 31, 1917, shows a depreciation of £5,044 8s. 7d.		
					Interest accrued on Investments		
					Income Tax recoverable		
					Cash at Bankers		
					£149,616 8 10		

To the Members of the Army Medical Officers' Widows and Orphans Fund.

We have examined the above Balance Sheet with the Books and Vouchers of the Society and certify that it is in accordance therewith. The Securities and Cash Balances have been verified by us.

DELOITTE, PLENDER, & CO., Auditors,
GRIFFITHS AND CO., Chartered Accountants.

5, London Wall Buildings,
Finsbury Circus, E.C.
March 12, 1918.

£149,616 8 10

During the past year a further sum of £3,000 from cash surplus has been invested in 5 per cent National War Bonds, which are repayable at 105 in 1927, and may be converted at any time after April 1 at the rate of £100 5 per cent War Stock for £95 nominal of National War Bonds.

It is hoped that members of the Society serving with the various Expeditionary Forces will bring to the notice of their brother officers the advantages of the Society and its very sound financial position. There must still be many whom notices, both individual and in the Corps Journal, have failed to reach.

*Royal Army Medical College,
April 15, 1918.*

*W. G. DON, Vice-President,
Deputy Surgeon-General,
Chairman of the Meeting of this date.*

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

THE Annual General Meeting of Subscribers to the Royal Army Medical Corps Central Mess Fund will be held in the Library of the Royal Army Medical College on Monday, June 10, 1918, following immediately that of the Royal Army Medical Corps Officers Benevolent Society. The Director-General will preside. Officers desiring information about this Fund are asked to communicate with the Honorary Secretary beforehand, so that there may be no delay in dealing with any questions which may be asked. Notice of any definite proposal which it may be desired to bring forward should be sent to the Honorary Secretary in order that it may appear on the agenda paper.

*3, Homefield Road,
Wimbledon, S.W.*

*J. T. CLAPHAM, Captain,
Honorary Secretary.*

THE Committee beg to submit the following Report on this Fund for the year 1917-18:—

The number of subscriptions (775) is slightly less than that of last year (779), but there are some twenty in arrear which will probably be paid.

It will be noticed that entrance fees appear for the first time in the Accounts. The payment of such by officers joining the Corps in the future was agreed upon at the Annual General Meeting in 1914, and those whose Commissions are dated January 1, 1917, are the first to be affected. They numbered 111 (of whom five have since been killed). A notice describing the objects of the Fund was sent to each of these, but, so far, only fifteen have become subscribers.

As to the grants made during the year, that to the Aldershot Mess was for maintenance purposes. The furniture of this Mess belongs to it, and the average number of officers dining (one regular and eight others) has been so small that the funds available for up-keep are quite inadequate. Although the London Mess is closed, it is liable for various insurances of Mess property and also for the annual contribution to the Pension Fund for Brewer and Elliott. A grant for these purposes was made. A small grant was also made, through the Aldershot Mess Committee, to the widow and orphans of the late G. Stacey, a well-known Mess servant for many years at Netley and Aldershot, for whom no pension arrangements had been made.

With the exception of the Curragh, which asked for help towards maintenance and afterwards withdrew its request, none other of the permanent messes has applied for assistance. There is reason to believe that several of them prefer to carry on without making any call on the Fund till the end of the War, when the demands upon it will be heavy.

The liability to Royal Army Medical Corps, Sierra Leone, is in respect of a sum handed over for custody at the outbreak of war.

The non-investment of cash surplus of the Fund during the past year is apparent rather than real. When the 5 per cent War Loan 1929-47 was issued in February, 1917, by the courtesy of Messrs. Holt and Co. the Cash balance of the Fund was reduced much below its customary level, in order that £400 of this Loan might be taken up, by anticipating the subscriptions for 1917-18, due a month later. The small amount of £13 8s. 3d. purchased during the past year was to bring the holding up to a round figure. It was thought advisable to show in the Balance Sheet the market value at the end of the year of the investments of the Fund.

For the past two years Aldershot and Rawal Pindi are the only messes which have applied to the Honorary Secretary for payment from the Central Fund of the joining and contributions of subscribers. The latter are reminded that they are not liable to any of the permanent messes for joining or difference-in-rank contributions; the amounts due for such should be claimed by mess secretaries from the Central Fund.

Officers on the retired list who subscribe to the Fund are considered Honorary Members of all the permanent messes of the Corps.

*3, Homefield Road,
Wimbledon, S.W.*

*J. T. CLAPHAM, Captain,
Honorary Secretary.*

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

Dr. CASH STATEMENT FOR THE YEAR ENDED FEBRUARY 28, 1918. *Cr.*

Income.		Expenditure.	
1917	£ s. d.	1917	£ s. d.
Mar. 1.		By Grants to Messes : London	79 4 6
		Aldershot	60 0 0
			189 4 6
		" Army and Navy Co-operative Society, Balance of Debt due from Scottish Command for Camp Canteen ..	6 6 2
		" Grant to Widow and Orphans of the late Mr. G. Stacey, per Aldershot Mess Committee	15 0 0
		" Joining, and difference-in-rank Contributions Paid to Messes on behalf of Subscribers—	9 18 0
		Aldershot	8 4 0
		Rawal Pindi	18 2 0
		" Purchase of £18 3s. 3d. 5 per cent. War Stock 1929/47 ..	12 10 2
		" Auditor's Fee	3 8 0
		" Office Expenses (for two years)—	
		Printing ..	1 19 10
		Typing ..	1 13 2
		Stamps ..	1 17 1
			5 10 1
		1918	
		Feb. 28.	
		Balance of Cash carried forward to 1918-19	573 8 8
			£773 4 7

BALANCE SHEET AT FEBRUARY 28, 1918.

<i>Liabilities.</i>	£ s. d.
Royal Army Medical Corps Entertainment Fund, Sierra Leone, held for ..	14 14 1
Balance	1,835 13 11
	£1,850 8 0

<i>Assets.</i>	£ s. d.
Investments (valued at approximate closing prices, February 28, 1918)— £1,150 War Loan 5 per cent Bonds 1923-47	1,073 1 10
£200 Exchequer 6 per cent Bonds, 1920	203 17 6
Cash at Bankers	573 8 8
	£1,850 8 0

April 23, 1918.

Audited and found correct
(Signed) EDMOND T. GANN.

(Signed) J. T. CLAPHAM, Captain,
Hon. Secretary.

ROYAL ARMY MEDICAL CORPS OFFICERS BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE,
ON APRIL 17, 1918.

Present :

Lieut.-Gen. T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., Director-General, in the Chair.
Major-Gen. Sir W. Donovan, K.C.B.
Col. H. W. Murray.
Lieut.-Col. A. B. Cottell.
Capt. J. T. Clapham.

- (1) The Minutes of the last meeting held on February 27 were read and confirmed.
- (2) A letter of regret was read from Surg. Gen. Sir D. Bruce for his inability to attend.
- (3) The accounts for 1917 which have now been audited were read and confirmed.
- (4) Correspondence was read relative to the suggested realizations of certain Railway Securities held by the Society and it was decided to take no action, but for the information of the general body of Subscribers to insert the present estimated value of these securities as well as the cost price when publishing the accounts in the Corps Journal.
- (5) The applications received on behalf of orphans for assistance were considered and recommendations made for decision by the Annual General Meeting. It was also decided to recommend that when inserting the grants authorized in the Corps Journal to indicate the recipients by initials only and to omit any reference to the rank of the father.
- (6) The date fixed for the Annual General Meeting, viz., Monday, June 10, was noted, and the Draft Report for the year 1917 was considered and approved.
- (7) It was decided to recommend the re-appointment of Lieut.-Col. E. M. Wilson as Secretary one year from June 20, 1918.

ROYAL ARMY MEDICAL CORPS FUND (Regular Army). ROYAL ARMY MEDICAL CORPS OFFICERS BENEVOLENT SOCIETY (Regular Army).

THE Annual General Meeting of the Royal Army Medical Corps Fund will be held in the Library of the Royal Army Medical Corps College, Grosvenor Road, S.W., at 2.30 p.m., on Monday, June 10, 1918.

The Director-General will preside.

It is hoped that all subscribers who can spare the time will be present, and will freely express their views on any point connected with the Fund.

The Annual General Meeting of the Royal Army Medical Corps Benevolent Society will take place immediately afterwards.

Any officers desiring information regarding these Funds are requested to communicate with the Secretary beforehand, so that there may be no delay in dealing with any questions asked.

124, Victoria Street, S.W.

E. M. WILSON, Lieut.-Col., Secretary.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE,
ON APRIL 17, 1918.

Present :

Lieut.-Gen. T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., Director-General, in the Chair.
Major-Gen. G. B. Stanistreet, C.M.G., Deputy Director-General.
Major-Gen. Sir W. Donovan, K.C.B.
Colonel Sir J. Magill, K.C.B.
Lieut.-Col. A. B. Cottell.
Major P. G. Easton, D.S.O.

- (1) The proceedings of the last meeting held on February 27 were read and confirmed.
- (2) A letter was read from Surg.-Gen. Sir D. Bruce regretting his inability to attend.
- (3) The accounts which have now been audited were approved.
- (4) The question of the further collection of "Press Cuttings" relating to the services of the Royal Army Medical Corps during the War was considered, and it was decided to request Captain J. T. Clapham to continue to receive and arrange such cuttings for one year from this date, the Fund to guarantee all necessary payments. Captain J. T. Clapham who was present kindly consented to undertake the task.
- (5) The Secretary submitted a rough draft of a proposed Book showing the formation, constitution, and objects of the Fund and its branches, and it was decided to appoint a Sub-Committee to consider the subject and to report before the Annual General Meeting. The Sub-Committee to consist of Major-Gen. Sir W. Donovan, Lieut.-Col. A. B. Cottell and the Secretary.
- (6) The Secretary reported grants which have been received for the General Relief Branch since the last meeting :—

Hospitals in Northern Command, York	..	..	£41	7	0
The Cambridge Hospital, Aldershot	..	..	12	1	0
43rd General Hospital, Salonika	..	..	5	0	0

Also an application for the renewal of a grant of £6 which had been made to an old soldier of the Corps. This was approved.

(7) Correspondence was read relative to a proposed memorial to a distinguished officer, and it was decided to submit it to the Memorials Sub-Committee with the request that they would co-opt Colonel C. E. Tyrrell, C.B., to serve with them, and to report to the Committee on the whole question, including what form the memorial, if any, should take, before the Annual General Meeting on June 10.

It was also decided to submit propositions regarding portraits of Directors-General to the same Sub-Committee, and to request their report at the same time.

(8) The date fixed for the Annual General Meeting on June 10 at the College was noted and the circular approved.

The draft report for the year 1917 was also considered and approved.

(9) Applications were received for assistance from the Royal Drummond Institution and the Home for Destitute Catholic Children, at both of which Schools children of the Corps are being educated, and it was decided that the former £12 and the latter £10 from the Compassionate School Fund.

(10) The payment of £25 annual subscription to the Royal School for Officers' Daughters at Bath was approved, and it was decided that the amount should be paid permanently from the Officers' Branch.

(11) The payment of the undermentioned subscriptions was approved, and it was decided that they should be a permanent charge upon the General Relief Branch:—

Union Jack Club	..	..	..	£25	4	0
Corps of Commissionaires	..	..	..	10	0	0
Soldiers' and Sailors' Help Society	..	..	..	5	0	0
National Association for Employment of Reserve and Disabled Soldiers	..	..	..	5	0	0

(12) The Committee decided to recommend to the Annual General Meeting that Lieut.-Col. E. M. Wilson be re-appointed Secretary for one year from June 20, 1918.

ROYAL ARMY MEDICAL CORPS COMFORTS FUND.

Telephone: Victoria 3722.

124, Victoria Street, S.W., March 14, 1918.

DEAR SIR,—I venture to appeal to you on behalf of the Non-Commissioned Officers and Men of the Corps at present detained as prisoners of war in enemy countries. I think that perhaps many companies and detachments at home and abroad, and medical units serving in the Field, may not be aware of what has been and is being done by the Ladies' Committee of the Royal Army Medical Corps Comforts Fund for the relief and assistance of our comrades in this unfortunate position, although notices have appeared in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS "Corps News" from time to time and letters have been sent to individual units.

From the early days of the War parcels of food and clothing and little additional comforts have been supplied regularly to all men known to be prisoners. In some instances where parcels could not be sent small sums of money have been forwarded through the authorized channels, and from the number of grateful letters that have been received not only from the men themselves but also from their relations at home, it is certain that the help thus given has been simply invaluable, and has greatly alleviated the hardships of the men.

Money has been very generously subscribed by the depot at Blackpool and other units and by many officers and friends, and the Ladies' Committee had never yet failed in the regular dispatch of parcels, &c.; but recently the number of prisoners has very largely increased, and there is a fear that unless further donations are received at an early date the funds may run short.

I feel certain that this has only to be brought to the notice of the Committees of Regimental Institutes at Home and Abroad to ensure the receipt of subscriptions sufficient to maintain the Fund for the duration of the War, and to prevent the possibility of any of our prisoners now or in the future being ever deprived of what is really necessary to their existence.

It will of course be understood that at the present time the vast majority of prisoners belong to the New Armies, Special Reserve, and Territorial Forces, and therefore all Canteen and Recreation Committees will be helping their own comrades.

The Annual Report for 1917 and Statement of Accounts is being published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS "Corps News," and will give full information regarding the Fund. All subscriptions should be sent to:—

The Hon. Secretary,
R.A.M.C. Comforts Fund, R.A.M.C. College,
Grosvenor Road, S.W.

or to me at the above address, and will be gratefully acknowledged.

Yours very truly,

E. M. WILSON, *Lieut.-Colonel.*
Hon. Treas., R.A.M.C. Comforts Fund.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF JANUARY, FEBRUARY AND MARCH, 1918.

Title of Work and Author	Edition	Date	How obtained
Text-Book of Ophthalmology. By H. E. Fuchs. Translated by A. Duane	5th	1917	Library Grant.
The Microtomists' Vade-Mecum. By Arthur B. Lee ..	7th	1918	" "
The Basis of Symptoms the Principles of Clinical Pathology. By Dr. Ludolph Krehl. Translated by Arthur F. Beifeld	4th	1917	" "
Hygiene and Public Health. By Whitelegge and Newman	13th	1917	" "
Serum and Vaccine Therapy. By R. T. Hewlett	2nd	1910	" "
The Refraction of the Eye. By G. Hartridge ..	15th	1911	" "
Post-mortem Manual. By C. R. Box ..		1910	" "
Injuries of the Face and Jaw and their Repair. By P. Martinier and Dr. G. Lemerle. Translated by H. Lawson Whale		1917	" "
A Practical Guide to the Inspection of Meat and Foods. By A. E. Bonham		1915	" "
Surgery of the Lung. By Garré and Quincke. Translated by D. M. Barcroft	2nd	1912	" "
The Diagnosis of Nervous Diseases. By Purves Stewart, C.B.	4th	1916	" "
The Indian Operation of Couching for Cataract. By Lieut.-Col. R. H. Elliot, I.M.S. (Ret.).		1917	" "
The Roentgen Diagnosis of the Alimentary Canal. By Carman and Miller		1917	" "
The Collected Papers of the Mayo Clinic. Vol. viii. Edited by Mrs. M. H. Mellish		1916	" "
An Atlas illustrating the Topographical Anatomy of the Neck, Thorax, Abdomen and Pelvis. By J. Symington		1917	" "
Tropical Diseases. By Sir Patrick Manson, G.C.M.G. ..	6th	1917	" "
Diseases of the Skin. By Sir Malcolm Morris, K.C.V.O.	6th	1917	" "
Blood Pictures: an Introduction to Clinical Hæmatology. By Cecil Price-Jones, Capt., R.A.M.C.		1917	" "
The Thyroid Gland in Health and Disease. By R. McCarrison		1917	" "
Nerve Wounds. By J. Tinel. Translated by F. Rothwell and C. A. Joll		1917	" "
Fibrositis. By Ll. Llewellyn and A. Bassett-Jones ..		1917	" "
The Practice of Medicine. By Sir Frederick Taylor, Bt.	11th	1918	" "
The Treatment of War Wounds. By W. W. Keen ..		1917	" "
Medical Electricity. By H. Lewis Jones ..	7th	1918	" "
Syphilis and the Army. By G. Thibierge. Edited by C. F. Marshall		1918	Editor, Journal.
Journal of the Royal Naval Medical Service, January ..		1918	The Editor.
Cerebrospinal Fever in the Royal Navy, August 1, 1916, to July 31, 1917. (Reprint.) By Temp. Surg.-Gen. H. D. Rolleston, C.B.		1918	The Author.
The Kitasato Archives of Experimental Medicine. Vol. i. No. 2. October		1917	The Editor.
Forty-sixth Annual Report of the Local Government Board, 1916-1917. Supplement containing the Report of the Medical Officer for 1916-1917		1917	Commandant's Office.
Physical Remedies for Disabled Soldiers. By R. Fortescue Fox		1917	Presented by Surg.-Gen. Sir M. W. Russell, C.B., A.M.S., K.C.M.A.

LIST OF BOOKS ADDED TO THE LIBRARY- *Continued.*

Title of Work and Author	Edition	Date	How obtained
The Story of British V.A.D. Work in the Great War. By Thekla Bowser, F.J.S.		1917	Presented by Lieut.- Col. G. E. Twiss, C.M.G., R.A.M.C.
My Four Years in Germany. By James W. Gerard ..		1917	" "
British Medicine in the War, 1914-1917		1917	Presented by Surg.- Gen. Sir D. Bruce, K.C.B., F.R.S.
Field Sanitation. By C. G. Moor and E. A. Cooper ..		1918	
History of the Delhi Coronation Durbar, 1903. By Stephen Wheeler		1904	Presented by Surg.- Gen. Sir W. Babbie, V.C., K.C.M.G., etc. Library Grant.
Dictionnaire des Termes de Médecine. Français-Anglais. Par H. De Meric		1899	
A German-English Dictionary for Chemists. By A. M. Patterson		1917	" "
The Practitioner's Medical Dictionary. By G. M. Gould.	3rd	1917	" "
Revised and Enlarged by R. J. E. Scott			
Le Paludisme Macédonien. Par Armand-Delile, Passeau, Abrami and Lemaire		1917	" "
Leishmaniosis, Kala-Azar, Bouton d'Orient, Leish- maniose américaine. Par A. Laveran		1917	" "
McNally's Sanitary Handbook for India. Revised and Re-written by A. J. H. Russell, I.M.S.		1916	" "
The Biology of Twins. By H. H. Newman		1917	" "
Twenty-two Months under Fire. By Brig.-Gen. H. Page Croft, C.M.G., M.P.		1917	" "
A Roumanian Diary, 1915, 1916, 1917. By Lady Kennard		1917	" "
In France and Flanders with the Fighting Men. By L. Maclean Watt		1917	" "
At the Serbian Front in Macedonia. By E. P. Stebbing		1917	" "
Observations of an Orderly. By Lance-Cpl. Ward Muir, R.A.M.C.(T.).		1917	" "
The Treatment of Infected Wounds. By A. Carrel and G. Dehelly. Translated by H. Child		1917	Presented by Sir A. Keogh, G.C.B.
Typhoid Fever and Paratyphoid Fevers. By H. Vincent and L. Muratet. Translated by J. D. Rolleston		1917	" "
The Psychoneurosis of War. By Dr. G. Roussy and J. Lehermitte. Translated by W. B. Christopherson		1918	" "
Hysteria or Pithiatism. By J. Babinski and J. Forment. Translated by J. D. Rolleston		1918	" "
The After-effects of Wounds of the Bones. By A. Broca. Translated by J. R. White		1918	" "
A Large Number of Books, Off-prints, and Correspondence on Tropical Medicine, especially Malaria, from the Library of Sir Ronald Ross, K.C.B., F.R.S., etc. (Not yet catalogued)			Presented by Sir Ronald Ross, K.C.B., F.R.S.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUND.

THE usual Quarterly Committee Meeting was held at 11, Chandos Street, Cavendish Square, W. 1, on April 26, 1918. Grants were made to the orphans of three commissioned officers of the Auxiliary Royal Army Medical Corps, and to the widows of three of the rank and file of the Auxiliary Branch of the Royal Army Medical Corps. Applications for Grants, and Subscriptions to the Funds should be addressed to the Hon. Secretary, 11, Chandos Street, Cavendish Square, W. 1.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

NUMBER OF REPRINTS	NUMBER OF PAGES	COST OF REPRINTS	COST OF EXCERPTS *	EXTRA FOR COVERS FOR REPRINTS			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
12	4	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
	8	0 2 9	0 1 2				
	16	0 5 0	0 2 8	4 8	1 1	8 10	0 9
25	4	0 8 4	0 1 5				
	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10				
	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 8	0 5 10				
100	4	0 6 0	0 3 1				
	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5				
	8	0 15 0	0 6 7	10 10	7 6	9 0	4 10
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. 6d. net; binding, 2s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C.

The back outside cover is not available for advertisements.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

WANTED to complete set of Journal of R.A.M.C. : 1916, Volume 26, Nos. 2, 3, 4 and 5; 1916, Volume 27, Nos. 1, 2 and 5. G. E. STECHERT & Co., 2, Star Yard, Carey Street, Chancery Lane, London, W.C. 2.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Abchurch Lane, Victoria Embankment, E.C. 4.

A Communication has been received from Captain A. L. Anthony.

The following publications have been received:—

British: The Journal of Tropical Medicine and Hygiene, Tropical Diseases Bulletin, Agricultural Research Institute, Pusa, Transactions of the Society of Tropical Medicine and Hygiene, The Quarterly Journal of Medicine, The Hospital, Public Health, Guy's Hospital Gazette, Surgery, Gynaecology and Obstetrics, The Medical Journal of Australia, The Medical Journal of South Africa, The Medical Press and Circular, The Royal Engineers' Journal, Commonwealth of Australia Quarantine Service, The Practitioner.

Foreign: Office International d'Hygiène Publique, Annali di Medicina Navale e Coloniale, Bulletin de l'Institut Pasteur, Archives de Médecine et de Pharmacie Militaires, Archives de Médecine et Pharmacie Navales, The Military Surgeon, Bulletin of the Johns Hopkins Hospital, The Journal of Infectious Diseases.

MANAGER'S NOTICES.

The **JOURNAL OF THE ROYAL ARMY MEDICAL CORPS** is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 3d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,

"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"

25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C.4.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

MAY, 1918.

War Office,

April 6, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated November 26, 1917, the following are the statements of service for which the decorations were conferred:—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Major (Temp. Lieut.-Col.) Patrick John Hanafin, D.S.O., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. For nine days he was continuously under heavy shell fire while supervising the evacuation of the wounded in the most adverse circumstances. Finally, although wounded in passing through a heavy barrage, he continued on duty until the last man had been brought in. The successful evacuation of the wounded was largely due to his gallant conduct.

Temp. Capt. Robert McCowan Hill, D.S.O., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. While on the way to battalion headquarters, his party was caught in an enemy barrage, and four of them were wounded. He at once dressed their wounds on the spot in a most exposed position and under heavy fire. On arriving at the aid post, he was informed that a whole machine-gun team were casualties in an advanced position. No stretcher-bearers were available, and he at once went forward and attended to them on the spot under heavy fire. He then returned and worked at his aid post under intense shelling, often attending to cases in the trench outside when the aid post was full. Casualties were being caused all round him, and he was wounded himself, but, though suffering severely, he remained at duty for sixteen hours, until the battalion was relieved. He set a most inspiring example of courage and devotion to duty to all ranks.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. James Churchill Dunn, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an attack. He worked with untiring energy in the open in the front line, searching for and dressing the wounded, and constantly exposing himself to machine-gun and rifle fire. His medical orderlies were both wounded, and the greater portion of his work was done without any assistance. He set a magnificent example to all of courage and devotion to duty under continuous heavy fire and enemy counter-attacks.

Temp. Capt. Ernest Harrison Griffith, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established his dressing-station well forward during an attack, and went up to the front line through a storm of artillery and machine-gun fire utterly regardless of personal safety. He moved about in the open for thirty-six hours without food or rest, attending to the wounded, often leading parties of bearers through heavy barrages until every wounded man had been carried back. He remained behind after the battalion was relieved, still searching for wounded, under heavy fire, though he was several times badly shaken by the explosion of shells. He set a most inspiring example of courage and devotion to duty.

Capt. and Brevet-Major Henry Forbes Panton, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. The evacuation of casualties, amounting to 60 officers and 1,100 men, after an advance of 3,000 yards was most successfully carried out, chiefly owing to the initiative and sound judgment displayed by him. He spent twenty-four

hours in the forward area, visiting every regimental aid post and sending back hourly reports until the battlefield was completely cleared of wounded.

AWARDED A BAR TO THE MILITARY CROSS.

Temp. Capt. William Thomson Brown, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He acted as bearer officer during an action, and was continuously in the open under heavy fire of all kinds. Though several times blown up by shells, he remained at work, and set a most inspiring example of courage and gallantry.

Temp. Lieut. (Temp. Capt.) Henry Alphonsus Harbison, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of divisional stretcher-bearers during several days' operations. For seventy-two hours he never slept, and was continually on the move under intense shell fire, establishing connexion with the regimental aid posts and leading and directing the bearers. The entire success of the evacuation of stretcher cases from the forward area was due to his magnificent example. His coolness, courage and endurance had a wonderful influence on his bearers. He has rendered conspicuous and valuable service on many other occasions.

Temp. Capt. Charles Reginald Ralston Huxtable, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. This officer worked for three days and nights under the most appalling conditions helping the wounded, being continually in the greatest danger. He finally collapsed on reaching camp.

Capt. George Reginald Edward Gray Mackay, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in personally supervising the evacuation of the wounded, making several journeys through a heavy barrage. On many previous occasions he has performed similar acts of gallantry.

Temp. Capt. Charles Joseph O'Reilly, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in personally supervising the evacuation of wounded, passing and repassing through heavy barrage fire. When a neighbouring medical officer was killed, he attached himself to the battalion and dressed and supervised the evacuation of the wounded.

Temp. Capt. John Finlayson McGill Sloan, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously for two days dressing over 150 cases in the open under heavy fire, three or four of the wounded being hit by snipers. He showed a fine example of coolness and sense of duty.

Temp. Capt. Gideon Walker, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked for twenty-four hours after an attack in an advanced area, getting in the wounded of two battalions, and remained in the line after his own battalion was relieved. He showed the greatest contempt of danger under heavy shell fire.

AWARDED THE MILITARY CROSS.

Capt. Charles Henry Brennan, Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He led his bearers fearlessly through heavy shell fire, and made a most valuable reconnaissance beyond the regimental aid post to find out if there were any wounded lying out. Though blown up and gassed, he remained at duty, setting a magnificent example to all.

Temp. Lieut. (Temp. Capt.) Raymond John Clausen, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously for forty-eight hours directing the stretcher-bearers and attending to the wounded under continuous shell fire. His cool courage and indomitable energy inspired his men and helped to save many lives.

Capt. George Crawshaw, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. His aid post was twice blown up, but he continued at his work in the open, attending to the wounded under heavy fire with utter disregard of his own safety. He set a magnificent example of courage and devotion to duty.

Temp. Capt. Douglas Erith Derry, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. While he was posting stretcher-bearers the locality was very heavily shelled and many men were wounded, but he succeeded in dressing and removing them all under heavy fire. Later, in a small dressing station, when the shelters were hit and damaged by shell fire, he showed a splendid example to all by his coolness and resource.

Temp. Capt. Thomas Duncan, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Though he was wounded on the way up to the line before an attack, he refused to go back, and carried out his duties under most difficult conditions, and though suffering considerable pain, throughout the operations. He was again wounded, but continued at work until ordered to have his wounds attended to.

Capt. Fred Ellis, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of stretcher-bearers during an action, and owing to his fearless and capable handling of his men, the evacuation of the wounded was carried out with great success and rapidity. He remained in the open for long periods superintending the work. His disregard of danger and devotion to duty were of the highest order.

Temp. Capt. Andrew Gaston, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an attack. He was untiring in his efforts to attend to the wounded under heavy shell fire and personally brought in many wounded men, often dressing their wounds first in the open. His courage inspired all the wounded with confidence and proved the finest example to his stretcher-bearers.

Capt. William Evans Graham, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of stretcher-bearers. By his utter disregard of danger he set a splendid example to his men, and carried out the evacuation of the wounded under heavy and continuous shell fire until he was severely wounded.

Temp. Capt. John Lewis Anderton Grout, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in conducting a number of stretcher-squads through very heavy shell fire to the aid posts after they had previously failed to get through. Two bearers were killed and three wounded, but by his gallant action over forty stretcher cases were got to safety. Later, he personally conducted squads to these aid posts under similar circumstances.

Temp. Lieut. Henry John Henderson, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established his aid post within 300 yards of the enemy's position and dressed and evacuated cases in the open. It was due to his splendid example, cheerfulness and courage that a great number of lives were saved.

Capt. Charles Edward Kynaston Herapath, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During two attacks he was in charge of the evacuation of the wounded from the regimental aid posts. On both occasions he moved about from post to post under very heavy shell fire, encouraging the stretcher-bearers and organizing the evacuation. It was largely owing to his conduct and example that 1,000 cases were got away successfully.

Capt. David Mackie, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty when in charge of a line of evacuation. For four days he worked continuously in the open, going through heavy barrages.

Temp. Capt. John Charsley Mackwood, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He attended to the wounded of eleven units in the open under heavy shell fire, working single-handed for several days. His self-sacrificing devotion to duty and his thoughtfulness and care of the wounded were beyond all praise.

Temp. Capt. William Strelley Martin, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in leading his bearers during seven days' operations through the most intense shelling with infinite resource and regardless of personal safety. It was due to his masterly organization and example that the wounded were collected so promptly.

Temp. Capt. John Louis Menzies, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in working continuously for thirty-six hours dressing and collecting wounded in the open under shell fire. When forced to take refuge his shelter was blown in and he himself badly shaken, and only saved by his steel helmet. He remained at his post, however, until relieved in the ordinary course.

Temp. Capt. James Bertram Mitton, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When in charge of stretcher-bearers, by his courage and example he was able to get many wounded men away. The district was almost continuously under heavy shell fire and the roads were in a very bad condition; but he overcame all difficulties in a most praiseworthy manner, and set a splendid example of courage and self-sacrifice.

Temp. Capt. John Henry Morris-Jones, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He carried on his duties at his aid post during an enemy attack under very heavy fire. He also visited wounded men who were lying out in the heaviest of the fire, and went up to the front line to attend to the wounded. He showed total disregard of his own safety, and encouraged all by his cheerful and courageous demeanour.

Temp. Capt. Joseph Herbert Porter, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of the divisional collecting post during an action, and by his example and thoroughness did much to encourage all ranks in the discharge of their duties. He went forward in charge of bearers, and by his untiring energy succeeded in getting his communications re-established in the face of great difficulties.

Temp. Capt. Norman Pallister Pritchard, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of his aid post during operations. It was entirely owing to his untiring care of the wounded and exertion in marshalling stretcher-bearers that all were eventually evacuated and lives saved thereby. Most of his work was done in the open under observed machine-gun fire.

Capt. James Purdie, Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. When he was informed that there were a number of wounded in the front line during an action he at once went forward with his stretcher-bearers under heavy fire, and remained in the front line dressing and collecting the wounded until all were cleared. He set a fine example of courage and devotion to duty.

Capt. James Rafter, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty in dressing wounded and organizing stretcher-bearers in the open under heavy shell fire during four days' operations without relief. By his splendidly sustained effort he undoubtedly saved many lives and much suffering.

Temp. Capt. Alan Randle, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He went forward during an action and personally cleared the battlefield of wounded, evacuating 120 cases in two hours under heavy shell fire. He showed great courage when casualties were caused by a bombardment during a relief.

Capt. Hugh Arthur Sandiford, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He took up a position immediately behind the front line during an attack, and dressed the wounded in the open. He displayed great coolness and gallantry under heavy artillery fire, working in an exposed position for forty-eight hours.

Temp. Capt. William Logan Scott, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked untiringly, attending to the wounded in the open under heavy fire during an engagement, and showed splendid courage and resource.

Capt. Frederic Battinson Smith, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked in a shell hole, attending to the wounded, throughout a very heavy bombardment. At night he frequently went out into No Man's Land with parties to bring in the wounded. He showed splendid courage and fearlessness.

Capt. Edwin Cyril Widmerpoole Starling, Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He remained day and night at his post under continuous shell fire, and was untiring in his work on behalf of the wounded, to whom his unremitting care and unruffled calmness was the greatest comfort and assistance. He set a splendid example of courage and self-sacrifice.

Temp. Capt. John Glyndor Treharne Thomas, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established a forward dressing station in an advanced position during an action, and though heavily shelled throughout the whole day, stuck to his post in a most courageous manner, and undoubtedly saved the lives of many men. He organized search parties, and himself carried in a number of badly wounded men under rifle and machine-gun fire.

Temp. Capt. John Aylmer Tippet, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When his dressing station was blown in, and nearly all the occupants killed, although much shaken, he immediately organized a new station, and for eight hours dressed and tended the wounded without rest. Later, when the battalion moved forward, he went through a heavy barrage to the new dressing station and worked continuously for six hours. During five days he had practically no rest, and dealt with some 300 casualties.

Capt. Adam Annand Turner, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He remained at duty for forty-eight hours under fire and without rest, and succeeded in getting all the wounded away rapidly from the aid posts and forward areas in spite of heavy enemy barrages. He set his men a splendid example of fearlessness and devotion to duty.

Temp. Capt. John Wilfred Watthews, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. His evacuation of the wounded during and after attack was carried out with wonderful organization and skill. He worked continuously for forty-eight hours attending to the wounded under hostile shell fire.

Capt. Harry Whitaker, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During an action he went forward, and, in spite of heavy shell and machine-gun fire, searched out and dressed the wounded in the most advanced positions. When a counter-attack developed he refused to leave his post until all the wounded had been removed. His courage and devotion to duty were an inspiration to all ranks.

Temp. Capt. Henry Dewi Hampton Willis-Bund, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of a dressing station which was destroyed by shell fire. Though rendered unconscious, he continued to attend to the wounded in the open when he recovered, accompanied the battalion into action, and remained at duty for forty-eight hours. He showed the greatest courage and devotion to duty.

War Office,
April 10, 1918.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Man :—

No. 58097 Pte. (Acting Serjt.) A. J. Tait, M.M., Royal Army Medical Corps (Edinburgh) (M.M. gazetted December 9, 1916.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 433083 Cpl. E. Busby (Dudley).
No. 434053 Pte. W. V. Clarke (Maidenhead).
No. 534388 Pte. H. Clemens (Hackney).
No. 536234 Serjt. H. W. Dalwood (Merton, S.W.).
No. 433106 Pte. E. J. Francis (Birmingham).
No. 21835 Pte. W. N. Hobday (Clapham Park, S.W.).

No. 433094 Lance-Cpl. W. Kettle (Birmingham).
No. 433093 Pte. F. E. Morris (Birmingham).
No. 223 Serjt. (Acting Staff-Serjt.) W. Peake (Laverthorpe, Yorks).
No. 434004 Serjt. (Acting Qmr. Serjt.) R. A. Rogers (Wolverton).
No. 534297 Serjt. C. R. Wellum (Limehouse).

AMENDMENT.

The following is the correct description of the Man whose name recently appeared in the *London Gazette* for the award of the Military Medal :—

No. 103662 Pte. C. E. Buzan, Royal Army Medical Corps. (Gazetted March 19, 1918.)

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
April 11, 1918.

The King has been graciously pleased to give directions for the following promotion in, and appointment to, the Most Distinguished Order of Saint Michael and St. George, for Distinguished Services in the Field in connexion with Military Operations, culminating in the capture of Jerusalem. Dated January, 1918 :—

To be Additional Member of the Third Class, or Companion, of the said Most Distinguished Order :—

Col. Richard Harman Luce, C.B., M.B., F.R.C.S., V.D.

War Office,
April 11, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for Distinguished Services in the Field in connexion with Military Operations, culminating in the capture of Jerusalem. Dated January 1, 1918 :—

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp.-Major James Johnston Abraham, M.D., F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) George Arthur Theodore Bray, Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) Robert John Cahill, M.B., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) Ernest Blair Dowsett, Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) Matthew Dunning, M.B., Royal Army Medical Corps.
Col. Evelyn John Robert Evatt, M.B., Royal Army Medical Corps.
Capt. (Acting Lieut.-Col.) Ernest Charles Lambkin, M.B., Royal Army Medical Corps.
Major (Temp. Col.) Hugh Richardson, M.D., Royal Army Medical Corps.
Temp. Lieut.-Col. Henry Wade, M.D., F.R.C.S., Royal Army Medical Corps.

AWARDED THE MILITARY CROSS.

Temp. Capt. Gerald Francis Bird, M.B., Royal Army Medical Corps.
Capt. Philip Stanley Martin, Royal Army Medical Corps.
Capt. Archibald Browning Mitchell, M.B., F.R.C.S., Royal Army Medical Corps.
Capt. James Mitchell Mitchell, M.B., Royal Army Medical Corps.

AWARDED THE DISTINGUISHED CONDUCT MEDAL.

No. 300059 Serjt. W. Davidson, Royal Army Medical Corps (Rothes).
No. 456014 Pte. J. P. Green, Royal Army Medical Corps (Bath.)

War Office,
April 15, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for Distinguished Services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question :—

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.
ORDRE DE LEOPOLD.

Chevalier.

Capt. Robert Godfrey Martyn, M.B., Royal Army Medical Corps, Special Reserve.

ORDER DE LEOPOLD II.

Decoration Militaire.

No. 19007 Staff-Serjt. (Acting Qmr.-Serjt.) John Richard Dare, Royal Army Medical Corps (New Kent Road, S.E.).

No. 7705 Pte. Stephen Albert Phillips, Royal Army Medical Corps.

Croix de Guerre.

Capt. Robert Godfrey Martyn, M.B., Royal Army Medical Corps, Special Reserve.

War Office,

April 18, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

LEGION D'HONNEUR.

Croix de Chevalier.

Col. Georges Etienne Beauchamp, Canadian Army Medical Corps.

Col. Wilfred William Ogilvy Beveridge, C.B., D.S.O., M.B., Army Medical Service.

Croix de Guerre.

Temp. Capt. Ernest Gerald Stanley, M.B., F.R.C.S., Royal Army Medical Corps.

Col. Thomas du Bedat Whaithe, C.M.G., M.B., Army Medical Service.

Temp. Capt. George Theodore Cregan, M.C., Royal Army Medical Corps.

Capt. John Francis Edmiston, M.B., Royal Army Medical Corps.

Capt. John Henry Pearson Fraser, M.B., Royal Army Medical Corps.

Capt. Stanley Rider Gibbs, Royal Army Medical Corps.

461455 Pte. Percy John Aslatt, Royal Army Medical Corps (Southampton).

461108 Serjt. Ernest Edward Frannmore Bolt, Royal Army Medical Corps (Portsmouth).

12261 Qmr.-Serjt. (Acting Serjt.-Major) John Evans Green, Royal Army Medical Corps (Enniskillen).

Temp. Lieut. Robert John Helsby, Royal Army Medical Corps.

63640 Pte. Henry Clifford Buckham, Royal Army Medical Corps (Newcastle-on-Tyne).

War Office,

April 22, 1918.

His Majesty the King has been graciously pleased to approve of the following awards to the undermentioned Officers in recognition of their Gallantry and Devotion to Duty in the Field :—

AWARDED THE MILITARY CROSS.

Temp. Capt. Cecil Francis Dillon-Kelly, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Establishing his regimental aid post in his captured enemy line, he himself kept in touch with the advanced troops and dressed the wounded under heavy machine-gun and rifle fire. He remained in the most advanced positions, dressing the wounded until every case had been evacuated, and showed an excellent example of disregard for danger and courageous determination.

Capt. Arthur Joseph Gordon Hunter, M.D., F.R.C.S., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. His battalion being engaged on both sides of the river at points a considerable distance apart, he repeatedly went out in the face of heavy machine-gun and rifle fire to organize the collection and evacuation of the wounded. His gallant behaviour and magnificent coolness inspired the men working under him with the utmost confidence.

Capt. Louis Laurence McKeever, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during an engagement. Hearing that there was no medical officer in the front line, he went forward at once under an intense bombardment and remained in the front line all night attending to the wounded under continuous and violent shell fire. He set a splendid example of courage and devotion to duty.

The amendment which was announced in the *London Gazette*, dated March 26, 1918, is cancelled, and the following substituted :—

Major (Temp. Lieut.-Col.) Charles Algernon Stidston, D.S.O., M.D., Royal Army Medical Corps. (D.S.O. gazetted February 4, 1918.)

War Office,
April 23, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated December 17, 1917, the following are the statements of Service for which the decorations were conferred:—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. (Temp. Lieut.-Col.) Charles Derwent Pye-Smith, D.S.O., M.C., M.B., F.R.C.S., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in command of the three field ambulances of the division during ten days' operations. Though the weather conditions were abnormally bad and a large number of the wounded of another division had not been evacuated, owing to his constant presence and influence all the wounded were got away promptly and without assistance from the Infantry.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. William Howard Lister, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty as bearer officer, taking parties to the regimental aid posts, though they suffered heavy casualties on the way. When a regimental medical officer was wounded, he attended to the wounded of this battalion, searching our lines and "No Man's Land" from midday to dark for wounded, and then returned to his field ambulance for another twelve hours' work until relieved.

Australian Imperial Force.

Capt. William Henry Collins, Army Medical Corps.

For conspicuous gallantry and devotion to duty. Finding that his regimental stretcher-bearers were unable to find a regimental aid post which he had established in a German "pill-box" he personally led the first party of them through an intense artillery and machine-gun fire barrage. Although knocked down by a bursting shell, he immediately resumed the dressing of the wounded. Although, owing to casualties, he had only two men to help him, he courageously persevered with his work and himself helped to excavate a dug-out for the wounded under heavy shell fire, during which several of the wounded were killed. He remained on duty for sixty hours, and refused to leave his post till the last wounded man had been evacuated. By his constant cheerfulness under the most averse conditions, and by his utter disregard of his own safety, he kept up the spirits of the wounded and stimulated his surviving helpers to their utmost efforts.

Major Eric Lloyd Hutchinson, Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of the evacuation of wounded from the forward area. He led a relief of stretcher-bearers over a track knee-deep in mud and at times over his waist in water. Another time he led a party through an intense barrage, thus relieving a temporary congestion of the wounded. He had very little rest during the whole four days.

Major Philip Alan Maplestone, Army Medical Corps.

For conspicuous gallantry and devotion to duty. When in charge of all stretcher-bearers and forward posts he showed the utmost coolness under heavy fire, during which several shelters were hit. By his example he prevented any panic and prevented serious casualties from gas shells. Although gassed himself, he remained on duty till the forenoon of the following day, having been on duty for over thirty hours. Even then he refused to be treated as a casualty, but after a short rest he returned to the advanced dressing station and carried on his duties.

AWARDED A BAR TO THE MILITARY CROSS.

Capt. Richard Thompson Caesar, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in evacuating the wounded. Under very heavy and continuous fire he systematically searched the battlefield from shell-hole to shell-hole for wounded, until he could report that all casualties had been removed.

Temp. Capt. John Maitland Forsyth, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in going up to the front line several times to search for and tend the wounded under heavy shelling and sniping. It was owing to his tireless energy that the casualties, which were very heavy, were so well evacuated. His aid post was twice hit by shells, once causing nine casualties to his bearers.

Capt. Cyril Jacobs, M.C., M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty in forming his dressing station under heavy fire. It was once blown in on top of him and five casualties occurred, but he remained at his post and managed to evacuate all wounded. On the following day he cleared the battlefield in spite of heavy fire, and brought back twenty badly wounded cases.

Temp. Capt. David Henry Russell, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in successfully evacuating a large number of wounded under constant shelling and in very bad weather conditions. He frequently helped to carry wounded, although himself exhausted.

Temp. Capt. Philip Randal Woodhouse, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When the battalion was formed up in the assembly area all the battalion medical staff except himself were wounded. He carried the medical haversacks all day and tended the wounded under fire. He was slightly wounded, but continued to work single-handed for two days.

AWARDED THE MILITARY CROSS.

Temp. Capt. Everard Cecil Abraham, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of a bearer division during seven days' operations. The rapid and efficient clearing of wounded from the field was largely due to his efforts. During a heavy gas shell bombardment he led his bearers through the barrage to rescue men affected by the gas.

Temp. Capt. William Robert Addis, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in superintending the clearing of wounded from regimental aid posts. The whole area was being heavily shelled, and during the latter part of the period he was gassed, but remained at work until the relief was finished.

Capt. Matthew Thomas Ascough, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in dressing wounded in the open for forty-eight hours without sleep or rest, under heavy shell fire, after his shelter had been rendered untenable by four direct hits.

Temp. Capt. Arthur Cecil Barker Biggs, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in supervising the removal of the wounded under very heavy fire during two days' operations. It was due to his extraordinary energy that the battlefield was kept clear of wounded, in spite of very adverse conditions.

Temp. Capt. George Alexander Birnie, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. In going forward with two stretcher-bearers to form an advanced aid post he was wounded in the shoulder by a piece of shell, one of the stretcher-bearers being killed at the same time. He continued dressing the wounded in our most advanced line, and even penetrated the enemy line of posts in search of casualties, keeping at his work until relieved some eight hours later.

Temp. Lieut. Charles Herbert Booth, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in tending the wounded in the open under continuous heavy shell fire. His skilful organizing of stretcher-bearers was undoubtedly the means of saving many lives.

Temp. Capt. Robert Briffault, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in organizing an aid post through which all casualties of the brigade, and those of many other units of the division, passed. He personally went up to the post and attended to men lying out in shell holes under very heavy fire. Although relieved, he actually went up beyond our forward posts to search for a wounded officer. Throughout the whole action he showed the utmost disregard of his personal safety.

Temp. Capt. George Edwin Chissell, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in tending the wounded both of his own battalion and others and organizing their evacuation. He worked continuously in the open for twenty-four hours under heavy shell and machine-gun fire. When the battalion was relieved he remained until the last of his brigade had been taken away.

Temp. Capt. Edward James Clark, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty as medical officer to a battalion. Though continuously under heavy shell fire he moved about in the open attending to the wounded, and undoubtedly saved many lives.

Temp. Lieut. Arthur Philip Draper, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He set a splendid example of courage and self-sacrifice in attending to the wounded during an action. He went forward and attended the wounded in the open when heavy casualties had been caused among the stretcher-bearers, and by his gallant conduct undoubtedly saved several lives.

Temp. Capt. Frederick Pearson Fisher, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On learning that the enemy had projected gas into one of our deep mine galleries, he descended to the bottom of the main shaft and established an aid post there. He then advanced with his party into the gassed area and rescued several miners. He remained at his post without relief for fourteen hours and saved many lives.

Capt. Hartas Foxton, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of the collection of wounded. He personally directed and visited all the regimental posts many times a day, often under heavy fire. By his energy he kept his bearers working, though exhausted, until the completion of the evacuation.

Capt. Reginald Douglas Gawn, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked untiringly, attending to the wounded under heavy fire during an attack. He made several journeys over most difficult ground to reach wounded men who were lying out in the open, and showed splendid courage and gallantry throughout.

Capt. Norman Bell Graham, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. He worked unceasingly under very heavy shell fire, attending to the wounded of several units. He organized stretcher parties and also went out himself to attend to the wounded. He set a splendid example of contempt of danger, and undoubtedly saved many lives.

Lieut. Arthur Robert Hill, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. He attended to the wounded during an attack in a very exposed position under heavy shell fire. He often moved about over the open searching for the wounded and assisting to move them. He showed great coolness and resource under the most difficult and dangerous conditions.

Capt. William Baly Jepson, Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. When a shell had smashed in battalion headquarters, although severely shaken himself, he dug out his commanding officer and the adjutant, and attended to them. He continuously took stretcher-bearers to the front line in daylight through intense shell fire. He established a new forward dressing station after the battalion had been relieved and did not return until he had searched the whole front for wounded.

Capt. Duncan Macfayden, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. He repeatedly went out to shell-holes under heavy fire to dress the wounded and help bring them in. He attended to the wounded of another battalion in addition to those of his own. He showed splendid courage and self-sacrifice.

Capt. Hugh Agnew Macmillan, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in passing some 600 cases through his regimental aid post though it was heavily bombarded. His staff being much depleted, he had to treat the majority of cases himself.

Capt. James McKay, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty in arranging the evacuation of stretcher cases from the front line. He continually dressed wounded, regardless of heavy shelling, in the open owing to limited accommodation.

Capt. John Pinder, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in attending to wounded under continuous shell fire. During two days and nights he worked in a shell-hole and sent back a large number of wounded men who would otherwise have died from exposure. He also went forward several times to the front line to attend to wounded men.

Temp. Capt. Charles Leslie Grove Powell, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in carrying on his work in the open under fire, though his advanced aid post was a special target for the enemy's artillery. He also visited the front line when it was being heavily shelled, to attend to cases that could not be moved.

Lieut. (Temp. Capt.) William Leonard Eliot Reynolds, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in working continuously for twenty-four hours amongst the wounded. In addition to his work at the Regimental Aid Post he went to the front line frequently, by day and night attending the wounded under heavy fire.

Capt. William Jack Scade, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When there was a large number of wounded in the aid post and no stretcher-bearers were available, he went back a distance of over a mile through a very heavy barrage, brought back stretcher-bearers and removed all the wounded. On the following day he went up to the front line under snipers' fire and brought back several wounded men. His courage and initiative were the means of saving many lives.

Capt. Charles Nixon Smith, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of the collection of casualties from the whole of the divisional front during active operations. For seven days he worked unceasingly without adequate sleep or food, and it was largely owing to his personal influence that the exhausted bearers were able and anxious to remain at work for so long a time.

Temp. Capt. William Steadman, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in superintending the loading of wounded men on to the tramway, and in assisting the stretcher-bearers, under heavy fire. He also repeatedly went in search of wounded, and was the means of bringing a large number to safety. Later, though gassed, he continued at duty.

Temp. Capt. Frederick Naylor Stewart, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He attended to the wounded during an action with utter disregard of danger, working in the open most of the day under persistent shell fire. He was untiring in his efforts on behalf of the wounded, and showed splendid courage and determination.

Temp. Lieut. (Temp. Capt.) Robert Ievers Sullivan, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in attending the wounded under heavy fire. He organized the stretcher-bearers, and for thirty-six hours searched in front of our out-posts for wounded men, thereby saving many lives.

Temp. Capt. Norman Charles Talbot, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On hearing that the batteries of the brigade were being heavily shelled, he dashed forward and dressed and collected over twenty wounded men.

Capt. Robert Fowler Walker, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty in tending the wounded in the open after the aid post had become a target for the enemy's howitzers. He was severely wounded, but would not allow the bearers to remove him until he had given instructions to his N.C.O., and made all possible arrangements for the care and comfort of the wounded.

Temp. Capt. Henry Currie Watson, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in working continuously for three days at an advance dressing station which was being constantly shelled. Although gassed he persisted in remaining at duty.

Temp. Lieut. Robert Everard Whitting, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He attended to the wounded during an engagement continuously for forty hours, working most of the time in the open under heavy shell fire. His courage and devotion to duty undoubtedly saved a very large number of lives.

Temp. Capt. Frederick Edward Saxby Willis, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in tending the wounded of his own and other units in advance of our front line and in forward positions which were fully exposed under heavy fire. It was largely due to his careful training and skilful arrangements that his bearers evacuated such a large proportion of the wounded of three units from the front area during the two days.

Australian Imperial Force.

Capt. Walter Leonard Smith, Army Medical Corps.

For conspicuous gallantry and devotion to duty while in charge of stretcher-bearers and posts. He did magnificent work in attending to the wounded and organizing their removal, and by his fearlessness and determination set a splendid example to his stretcher-bearers.

New Zealand Force.

Lieut. Robert Hector Baxter, Medical Corps.

For conspicuous gallantry and devotion to duty in working for three days at his regimental aid posts under continual exposure to shell and machine-gun fire.

Capt. Frederick William Lumsden, Medical Corps.

For conspicuous gallantry and devotion to duty in dressing wounded in the open when the regimental aid post, which was within 700 yards of the enemy "pill-boxes" and in full view of them, was still full of wounded left by the previous battalion. Casualties were inflicted even on the stretcher cases. Though exposed to this fire, he worked unremittingly for three days with practically no sleep and very little food until quite exhausted.

Capt. John McGhie, Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of bearers. Time after time he took stretcher parties forward through heavy mud and enemy barrages to the regimental aid post, and did not stop till he was certain that all men lying out had been collected.

Capt. Sydney Devenish Rhind, Medical Corps.

For conspicuous gallantry and devotion to duty for three days and nights at his regimental aid post, repeatedly having to attend to men outside under heavy fire. He also organized parties of stretcher-bearers for their removal.

Capt. Samuel Llewellyn Serpell, Medical Corps.

For conspicuous gallantry and devotion to duty in attending to the wounded at the regimental aid post under heavy fire. Although twice wounded, he went on with his work until ordered to hospital by his commanding officer.

South African Force.

Temp. Capt. Alistair Gordon Forbes, Medical Corps.

For conspicuous gallantry and devotion to duty. After continuous dressing of thirty wounded he personally took a place in one of the squads of bearers under heavy fire of gas and other

shells, and so stimulated his exhausted bearers to special efforts. Though suffering from mustard gas-poisoning, he remained at work until ordered back as a casualty two days later.

Note.—Since the publication of these Officers' names in the *Gazette* of December 17, 1917, promotion has in some cases been conferred, and the ranks herein shown are not therefore in all cases those now held.

ARMY MEDICAL SERVICE.

The undermentioned Colonels to be Major-Generals:—

(Temp. Major-Gen.) Oliver R. A. Julian, C.B., C.M.G., *vice* Major-Gen. F. J. Jencken, retired, dated April 4, 1918.

Stuart Macdonald, C.M.G., M.B., *vice* Major-Gen. H. G. Hathaway retired, dated April 7, 1918. (Temp. Major-Gen.) Maurice P. C. Holt, K.C.M.G., C.B., D.S.O., *vice* Major-Gen. Sir F. H. Treherne, K.C.M.G., retired, dated April 15, 1918.

The undermentioned Lieutenant-Colonels from the Royal Army Medical Corps to be Colonels:—

Dated April 7, 1918.—(Brevet-Col.) Thomas W. Gibbard, M.B., K.H.S.; William E. Hardy.

Dated April 15, 1918.—Henry N. Dunn, C.M.G., D.S.O.

Dated April 25, 1918.—Edward M. Morphew, D.S.O.

Lieut.-Col. John Grech, D.S.O., relinquishes the temporary rank of Colonel on re-posting, dated March 7, 1918.

The undermentioned Lieutenant-Colonels to be Temporary Colonels whilst employed as Assistant Directors of Medical Services of Divisions:—

Norman Faichnie, M.B., dated March 7, 1918.

Bernard B. Burke, D.S.O., dated March 16, 1918.

Col. (Temp. Major-Gen.) Bruce M. Skinner, C.M.G., M.V.O., retired list, relinquishes his temporary rank, and is granted the honorary rank of Major-General, dated April 25, 1918.

ROYAL ARMY MEDICAL CORPS.

Brevet-Col. Henry Aylmer Haines, M.D., is placed on retired pay, dated May 2, 1918.

The undermentioned Temporary Captains to be Acting Majors, dated January 4, 1918:—

Herbert A. Lake.

Lieut. (Temp. Capt.) Galvin A. E. Argo, M.B.

Tremlett B. Batchelor.

Henry Moore, M.C.

Alexander W. Rattrie, M.B.

Arthur Richmond, M.C., M.B.

Lieut. (Temp. Capt.) Henry A. Harbinson, M.C., M.B.

Albert F. Mavety, M.B. (from January 4 to January 29, 1918).

Francis J. O. King, M.B.

Lieut. (Temp. Capt.) Harold A. Rowell, M.C.

Duncan M. Morison, M.B.

Geoffrey T. Baker (from January 4 to January 15, 1918).

Alan R. Finn, M.D., F.R.C.S. (from January 4 to February 9, 1918).

Augustin P. Fry, M.B. (from January 4 to February 15, 1918).

Walter S. Danks, M.D.

John Gibson, M.B.

Victor L. Connolly, M.C., M.B.

John B. Lowe.

Lieut. (Temp. Capt.) Raymond J. Clausen, M.C., M.B.

William T. Brown, M.C., M.B.

George D. R. Carr, M.C.

James F. Robertson.

Archibald S. K. Anderson, D.S.O., M.C., M.B.

Hugh Young, M.B.

Herbert H. Sampson, M.C., M.B., F.R.C.S.

John Anderson, D.S.O., M.B.

Sidney J. Rowntree,

William Rankin, M.B.

Frederick B. Manser, M.B.

James D. Hart, M.C., M.B.

Alexander Mearns, M.B.

Henry W. Batchelor.

Bertram H. Barton, M.C., M.D.

Herbert H. Warren, M.B.

Harold R. Grellet.

Herbert M. Vickers, M.B.

George Buchanan, M.B.

William J. A. B. Wishart, M.B.

David S. Brough, M.C., M.B.

Francis H. McCaughey, M.B. (from January 4 to February 15, 1918).

Robert C. Irvine, M.B.

Sol. Cross, M.B. (from January 4 to March 8, 1918).

Francis de S. McMenamin, M.B.

James A. Doull, M.B.

Robert Svensson, M.B.

Maurice A. Power, M.C., M.B.

John B. Hayercraft, M.B.

John S. Arkle, M.B.

Richard C. Alexander, M.B., F.R.C.S. Edin.

Arthur T. Edwards, F.R.C.S.

Harold B. Day, M.C., M.D.

Arthur W. H. Donaldson, M.B.

Joseph B. Cook, M.D.

Richard Charles, F.R.C.S.I.

Thomas C. Ritchie, M.B.

Wilfred G. Mumford, M.B., F.R.C.S.

Allan G. Hamilton, M.B., F.R.C.S. Edin.

Francis G. Bell, M.C., M.D., F.R.C.S.

Richard T. Worthington, M.B.

Thomas I. Bennett, M.B.

Stanley G. Luker, M.D.

Charles L. T. Arthur, M.D.

Harold Dunkerley.

Lieut. (Temp. Capt.) James La F. Lauder, D.S.O., M.C.

Hubert F. Wilson, M.C., M.B.

John P. Davidson, M.C., M.B.

Joseph S. Doyle, M.B.

George E. Neligan, M.C., M.B., F.R.C.S.

Anson R. Jordan, M.B., F.R.C.S.

John H. Thornley, M.B.

William Anderson, M.B., F.R.C.S.

Dated January 13, 1918.—William F. Morgan.
 Dated January 17, 1918.—Francis C. Lees.
 Dated January 29, 1918.—Francis F. Fahy, M.B.; Harold B. Day, M.C., M.D.
 Dated February 3, 1918.—Cecil A. Boyd, M.B.; Harold W. Scawin.
 Dated February 12, 1918.—Charles B. Davies, M.C.
 Dated February 17, 1918.—Victor H. Mason, M.C., M.B.
 Dated from February 23 to March 1, 1918.—William A. Hislop, M.B.
 Dated February 23, 1918.—Victor B. Kyle, M.D.
 Dated February 25, 1918.—Hugh B. German, M.C.
 Dated March 1, 1918.—Robert M. Greig, M.B.
 Dated March 6, 1918.—John R. P. Allin; Vivian M. Rich, M.B.; Robert B. Rutherford, M.B.; William C. Douglass.
 Dated March 9, 1918.—John E. Davies.
 Dated March 15, 1918.—Henry W. Turner.
 Dated March 20, 1918.—Philip Carney, M.B.
 Dated March 22, 1918.—Arthur Sunderland; (Temp. Lieut.) Hyam Goodman, M.B.; Robert J. B. Madden, M.C., M.B.
 Temp. Capt. Clement R. Macleod, M.C., M.B., relinquishes the acting rank of Major on re-posting, dated March 21, 1918.

The undermentioned Captains to be Acting Majors, dated January 4, 1918.—
 William McK. H. McCullagh, D.S.O., M.C.,
 M.B.
 Cyril J. B. Way, M.C.
 Reginald H. Leigh, M.C.
 Charles M. Page, M.B., F.R.C.S.
 Percy B. Corbett, M.B. (from January 4 to March 6, 1918.)
 John Inkster, M.D. (from January 4 to March 1, 1918).
 Thomas W. Clarke, M.C., M.B.
 (Brevet-Major) Ronald C. Ozanne, M.B.
 Bernard Goldsmith.
 Ernest M. Cowell, M.D., F.R.C.S.
 William McN. Walker, M.B.
 James C. Young, M.D. (from January 4 to February 22, 1918).

Dated February 21, 1918.—Robert A. Flood, M.B.
 Dated March 6, 1918.—John Rowe, M.B.; Noel T. Whitehead, M.C., M.B.
 The undermentioned to be Acting Major, dated January 4, 1918 :—
 Temp. Major Gordon Taylor, M.B., F.R.C.S.
 Capt. George H. C. Mold, M.B., relinquishes the acting rank of Major on re-posting, dated March 8, 1918.
 Henry Mearns Savery, from University of London Contingent, O.T.C., to be Lieutenant, dated April 22, 1918.

The undermentioned Majors to be Lieutenant-Colonels :—
 Dated March 29, 1918.—Arthur R. C. Parsons.
 Dated April 4, 1918.—Eyre W. Powell.
 Dated April 7, 1918.—Charles H. Carr, M.D.; Edmund Bennett.
 Dated April 15, 1918.—Arthur C. Adderley.
 Dated April 25, 1918.—Sir Edward S. Worthington, Kt., C.M.G., M.V.O.
 Major Reginald V. Cowey, D.S.O., relinquishes the acting rank of Lieutenant-Colonel on re-posting, dated March 18, 1918.

The undermentioned to be Acting Lieutenant-Colonel :—
 Major (Brevet Lieut.-Col.) Barry A. Craig, whilst in command of a Medical Unit, dated January 18, 1918.

The undermentioned to be Acting Lieutenant-Colonels whilst specially employed, dated March 29, 1918 :—
 Temp. Major Donald K. McDowell, C.M.G.; Capt. Ernest B. Lathbury.
 Major Travis C. Lucas, M.B., is placed on the half-pay list on account of ill-health contracted on Active Service, dated April 3, 1918.

The undermentioned Temporary Captains to be Acting Majors whilst specially employed, dated March 29, 1918 :—
 Frederick J. Thorne, M.B.
 Oswin Shields, M.D.
 William F. Abbott.
 Walter Fell, M.D.
 Harold K. Graham Hodgson, M.B.
 Butler Hogan.
 Aubrey K. H. Pollock.

Maurice Craig, M.D., F.R.C.P., to be Temporary Lieutenant-Colonel, dated May 1, 1918.
 The undermentioned relinquish the acting rank of Major on re-posting :—
 Temp. Capt. David S. Brough, M.C., M.B., dated February 22, 1918.
 Capt. Raymond J. Clausen, M.C., M.B., dated March 8, 1918.
 Temp. Capt. Cyril A. Bernard, M.C., dated March 19, 1918.
 Temp. Capt. Guy W. Parry, M.C., dated March 28, 1918.

ROYAL ARMY MEDICAL CORPS COMFORTS AND PRISONERS OF WAR FUND.

THE Honorary Treasurer thinks that the following list of contributions from companies and units at Home and Abroad to our Prisoners of War Fund will be of general interest to the Corps.

Owing to the very large number of donations it is impossible to show the gifts from individual Officers and other friends and the present list of units is only amounts received up to the end of April. It is hoped to publish other lists at an early date.

All donations are acknowledged at once either by the Honorary Treasurer or the Honorary Secretary, and contributors may rest assured that all money sent is expended solely for Prisoners of War, as the Ladies' Committee have decided to suspend entirely the supply of Comforts to the Units in the Field whilst we have men of our own Corps in captivity.

E. M. WILSON, *Lieut.-Colonel,*
Hon. Treas., R.A.M.C. Comforts and Prisoners of War Fund.

LIST OF COMPANIES AND UNITS—AT HOME AND ABROAD—CONTRIBUTIONS TO PRISONERS OF WAR FUND IN 1918.

January—		April—	
Proceeds of concert by "V" Com-		61st Casualty Clearing Station ..	£88 0 0
pany R.A.M.C. Training Centre,		53rd General Hospital ..	60 1 1
Blackpool	£12 1 6	103rd Field Ambulance ..	20 0 0
R.A.M.C. Training Centre Details		Col. H. Ensor and Officers' Mess,	
(late Ripon Training Centre) ..	150 0 0	8th F.A. ..	19 0 9
Officers' Mess	10 13 8	Central Military Hospital, East-	
R.A.M.C. Depot, Blackpool ..	100 0 0	bourne	8 6 0
February—		Milford Haven Garrison R.A.M.C.	2 6 0
Training Brigades R.A.M.C.,		16 Company, R.A.M.C., and	
Blackpool	35 12 1	134 F.A. (T.F.), Limerick ..	10 0 0
Regimental Institutes R.A.M.C.,		39th Stationary Hospital, B.E.F.,	
Blackpool	500 0 0	France	25 0 0
March—		King George's Military Hospital,	
R.A.M.C. Training Centre Details,		Dublin, Officers, N.C.O.s and	
Blackpool	100 0 0	Men	83 12 6
"	14 17 2	5th Southern General Hospital, T.F.	5 5 0
Regimental Institutes:		Belfast Ulster Volunteer Force	
No. 7 Company, Devonport ..	10 0 0	Hospital	3 3 0
No. 10 Company, Chatham ..	20 0 0	Officers' Mess, 58th Scottish	
No. 2, General Hospital B.E.F.,		General Hospital	13 0 0
France	10 0 0	334 1st London Field Ambulance	5 0 0
15 Company, Belfast	2 0 0	139th St. John's Field Ambulance	5 10 0
April—		2/1st North Midland Field Ambu-	
7th Training Battalion, Blackpool	5 0 0	lance	20 0 0
No. 1 Company, Cambridge Hos-		34th Field Ambulance	5 10 0
pital	50 0 0	135th Field Ambulance	22 0 0
No. 1 Company, Cambridge Hos-		No. 8, General Hospital, B.E.F.,	
pital, Sergeants' Mess	10 0 0	France	25 0 0
Officers' 3rd Scottish General Hos-		No. 9 Company, R.A.M.C., Col-	
pital, T.F.	13 5 0	chester, and detachments ..	181 10 0
317 Field Ambulance	10 0 0	47th Field Ambulance, B.E.F.,	
Officers' Headquarters Staff A.M.S.		France	18 6 8
Southern Command, Salisbury	8 14 0	25th Stationary Hospital, B.E.F.,	
24th Sanitary Section	1 10 0	France	11 5 2

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

THE Annual General Meeting of Subscribers to the Royal Army Medical Corps Central Mess Fund will be held in the Library of the Royal Army Medical College on Monday, June 10, 1918, following immediately that of the Royal Army Medical Corps Officers' Benevolent Society. The Director-General will preside. Officers desiring information about this Fund are asked to communicate with the Honorary Secretary beforehand, so that there may be no delay in dealing with any questions which may be asked. Notice of any definite proposal which it may be desired to bring forward should be sent to the Honorary Secretary in order that it may appear on the agenda paper.

3, Homefield Road,
Wimbledon, S.W.

J. T. CLAPHAM, *Captain,*
Honorary Secretary.

**ROYAL ARMY MEDICAL CORPS FUND (Regular Army).
ROYAL ARMY MEDICAL CORPS OFFICERS
BENEVOLENT SOCIETY (Regular Army).**

THE Annual General Meeting of the Royal Army Medical Corps Fund will be held in the Library of the Royal Army Medical Corps College, Grosvenor Road, S.W., at 2.30 p.m., on Monday, June 10, 1918.

The Director-General will preside.

It is hoped that all subscribers who can spare the time will be present, and will freely express their views on any point connected with the Fund.

The Annual General Meeting of the Royal Army Medical Corps Benevolent Society will take place immediately afterwards.

Any officers desiring information regarding these Funds are requested to communicate with the Secretary beforehand, so that there may be no delay in dealing with any questions asked.

124, Victoria Street, S.W.

E. M. WILSON, Lieut.-Col., Secretary.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adelphi House, Victoria Embankment, E.C. 4.

A Communication has been received from Lieut.-Col. W. E. Lunn.

The following publications have been received:—

British: The Medical Press and Circular, Journal of the Royal Naval Medical Service, Tropical Veterinary Bulletin, St. Bartholomew's Hospital Journal, The Journal of State Medicine, The Hospital, The Medical Journal of Australia, Guy's Hospital Gazette, Edinburgh Medical Journal, The Journal of Tropical Medicine and Hygiene, The Indian Medical Gazette, The Medical Review, The British Journal of Nursing, The Indian Journal of Medical Research, The British Journal of Tuberculosis, Tropical Diseases Bulletin, The Practitioner, Recalled to Life, Bulletin of the Canadian Army Medical Corps, The Hospital, The Royal Engineer's Journal, The Medical Journal of South Africa.

Foreign: Archives de Médecine et Pharmacie Navales, Bulletin de l'Institut Pasteur, Bulletin de la Société de Pathologie Exotique, Archives de l'Institut Pasteur de Tunis, Journal of Agricultural Research, Archives Médicales Belges, Memorias do Instituto Oswaldo Cruz, Le Caducée, Office International d'Hygiène Publique, Giornale di Medicina Militare, Mededeelingen van den Burgerlijken Geneeskundigen Dienst in Nederlandsch-indië, Colonies et Marine, United States Journal of the Department of Public Health, Surgery, Gynecology and Obstetrics (U.S.A.).

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

NUMBER OF REPRINTS	NUMBER OF PAGES	COST OF REPRINTS	COST OF EXCERPTS *	EXTRA FOR COVERS FOR REPRINTS			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
12	4	£ s. d. 0 2 9	£ s. d. 0 1 2	4 3	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. 6d. net; binding, 2s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C.

The back outside cover is not available for advertisements.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C." and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,

"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"

25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C.4.

JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.

Corps News.

JUNE, 1918.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
April 25, 1918.

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officer and Men:—

ROYAL ARMY MEDICAL CORPS.

No. 408069 Pte. H. Bolton (Leeds).
No. 38122 Pte. A. Coad (Truro).
No. 408424 Pte. J. Edgell (Leeds).
No. 32763 Pte. J. W. Flower (Sheffield).
No. 65201 Pte. F. B. Hands (Edgbaston).
No. 38161 Pte. G. F. Harris (Somers Town).
No. 37479 Pte. W. Jackson (Birmingham).
No. 68445 Pte. J. B. Jones (Merthyr Tydvil).

No. 318033 Serjt. F. J. Johnstone (Glasgow).
No. 37475 Pte. H. S. Lilley (Bolton).
No. 37546 Pte. C. W. Linscott (S. Bermondsey).
No. 92903 Pte. A. J. G. Mackie (Carron).
No. 90768 Pte. H. E. McIlroy (Paddington).
No. 386033 Pte. W. C. Thompson (Newcastle-on-Tyne).

With reference to the awards conferred as announced in the *London Gazette*, dated January 18, 1918, the following are the statements of service for which the decorations were conferred:—

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. Archibald Stirling Kennedy Anderson, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Under heavy shell fire he led forward a party of stretcher-bearers and collected twenty-five wounded men who were lying within fifty yards of the enemy line. He set a splendid example of courage and self-sacrifice.

Temp. Capt. James Thornley Bowman, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During an attack he attended to the wounded for five hours in the open under heavy fire. He showed the greatest coolness and courage throughout the day.

Temp. Capt. Howard Boyd Graham, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During a heavy barrage he personally reconnoitred the advanced aid posts, with the result that many cases were evacuated the moment the barrage lifted. This action undoubtedly saved many lives. On another occasion he went out and brought in two officers and four other ranks who were lying out unattended. Later, hearing that an officer had become a casualty, he went forward and brought him back single-handed to a point whence he was evacuated. His coolness, fearlessness and devotion to duty were beyond praise.

Capt. (Acting Lieut.-Col.) Robert Thin Craig Robertson, M.B., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. When two ammunition lorries were hit by enemy shells he went forward at great risk to where several men had been killed or wounded, dressed their wounds and had them evacuated. He displayed great initiative and coolness.

AWARDED A SECOND BAR TO THE MILITARY CROSS.

Temp. Capt. George D'Rastrik Carr, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He reconnoitred a route for his bearers under heavy shelling. From 4 a.m. till late the following evening he was continually under heavy fire between his collecting post and the regimental aid post. His constant knowledge of events in the first line enabled only the requisite number of bearers to be used in the more dangerous parts.

AWARDED A BAR TO THE MILITARY CROSS.

Capt. Robert Bell Stewart, M.C., Royal Army Medical Corps (Special Reserve).

For conspicuous gallantry and devotion to duty. He successfully carried out the evacuation of the wounded from the regimental aid post over extremely bad ground and under very heavy fire.

Temp. Capt. Francis Ruthven Thornton, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of bearers, evacuating the wounded under very adverse weather conditions. When, owing to an intense barrage, bearers repeatedly failed to get through to the advanced regimental aid post he personally led them forward and remained there for ten hours, evacuating thirty-six serious cases.

AWARDED THE MILITARY CROSS.

Temp. Capt. John Frederick Broughton, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in attending the wounded in an exposed aid post under heavy fire throughout the day. He visited the advanced positions whenever he could to organize his bearers and collect wounded. After the battalion was relieved he stayed in the line all the following day to search for wounded. When the medical officer of a neighbouring battalion became a casualty he passed from one aid post to the other under heavy fire and attended to the wounded of both battalions.

Capt. Angus Cameron, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During the attack he handled his company in a most capable manner. When the objective was reached, he collected men of several units, and consolidated the position. It was owing to his prompt action that two bombing attacks were easily repulsed. During the whole operation his courage and cheerfulness were the means of inspiring all ranks.

Temp. Lieut. (Temp. Capt.) William Kealty Campbell, D.S.O., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. In searching for wounded he and his party came under heavy fire. Ordering his bearers to take cover in shell-holes, he searched the ground by himself, calling up bearers as he required them. When moving away with the last wounded man a shell severely wounded one of the bearers. Ordering the remainder to take their stretcher case into a "pill-box," he remained in the open with the wounded bearer till he died.

Temp. Capt. Charles Launder Chalk, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. This officer displayed great initiative under shell fire. When his dressing station was crowded with wounded he dressed in the open those who were unable to find cover. Through his promptitude and heedlessness of danger in dressing and clearing away the wounded he undoubtedly saved many lives during a critical period.

Capt. Joseph Wilfred Craven, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of bearer parties removing the wounded. Discovering many wounded in an old enemy "pill-box," he returned for bearers, and so saved the lives of one officer and six men. During the whole time he was under severe machine-gun fire and shrapnel.

Temp. Capt. Henzell Howard Dummere, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He voluntarily left shelter and went across difficult ground under very heavy fire to help three seriously wounded men, afterwards conducting the stretcher-bearers to the aid post a mile away.

Temp. Capt. John Tryweryn Lloyd, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty as battalion medical officer. He frequently went forward under heavy machine-gun and shell fire to supervise the work of his stretcher-bearers.

Temp. Capt. James MacGregor, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of a bearer division. He followed up the barrage closely and evacuated the wounded under heavy fire. By magnificent work he cleared the ground of wounded before dusk.

Temp. Capt. James Murdoch MacKay, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He remained at work although suffering from gas-poisoning, and continually left the aid post to direct his orderlies and bring in walking wounded cases.

Temp. Capt. David Matthew, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during two days' heavy fighting. He established a dressing station in an advanced position whence he continually went forward to dress wounded and organize carrying parties under heavy fire. He inspired his men to continue their work by his splendid example.

Capt. Alfred James Angel McCabe-Dallas, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Seeing a trench some distance off being heavily shelled, although not in medical charge of the troops occupying it he at once ran to see if he could help any casualties, and while doing so was severely wounded.

Capt. Philip McRitchie, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Coming upon a party of sixteen men wounded by shell fire, he dressed their wounds under a heavy barrage and called for volunteers

to carry them to the aid post. Hearing that his Commanding Officer and Adjutant had been wounded about a mile away, he made his way across country under heavy fire and got them to the dressing station.

Capt. Edgar Percival, D.S.O., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in command of stretcher-bearers. While he was leading a party of sixteen towards the aid post they came under heavy shell fire, and seven were wounded. He got them back and brought up fresh men. One of this party was wounded, and, while an attempt was being made to get him back the patient and three bearers were killed. After replacing these casualties he succeeded in getting through at the third attempt, and removed all the wounded.

Temp. Capt. Maurice Aloysius Power, M.B., R.A.M.C.

For conspicuous gallantry and devotion to duty when in charge of a bearer division. He collected and dressed wounded under heavy fire. On the way to the aid post his bearer was killed by a shell and he was wounded, but he succeeded in clearing his sector of wounded before dark, and then had to be assisted in an exhausted condition to the dressing station.

Temp. Capt. Reginald Thompson Raine, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During an intense barrage he went out in the open to attend to wounded, and when his stretcher-bearers became casualties he himself carried cases in. Returning later he also brought in the stretcher-bearers, though exposed all the while to an intense shell fire. He showed a magnificent example to all, and undoubtedly saved many lives.

Capt. Christopher Rogers, M.B., R.A.M.C.

For conspicuous gallantry and devotion to duty as medical officer to his battalion during an attack. When his aid post was blown in, and all his staff killed or wounded, he remained at his post, working in the open under continuous shell fire over twenty hours, 200 cases passing through his hands. After most of his stretcher-bearers had been killed or wounded, he brought in a large number of wounded himself until he was exhausted.

Capt. John Gray Ronaldson, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty while in charge of bearers for nine days, almost without rest. He several times went forward under heavy shell fire to attend to gunners who were wounded and lying in the open. During a heavy gas bombardment, in which there were many casualties, he was himself gassed.

Temp. Capt. Reginald Herman Tribe, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Having organized an aid post behind the front line, he dealt untiringly with many wounded cases belonging to several different units, his courage and efforts being the means of saving many lives and much suffering. He showed splendid determination and resource.

COMMUNIQUE.

N.B.—This List is for publication in the Press only, and will not be gazetted.

War Office,

May 1, 1918.

The undermentioned is added to the names of those who have been brought to the notice of the Secretary of State for War for valuable services rendered in connection with the War, published on March 13, 1918:—

Capt. (Temp. Major) O. Challis, Royal Army Medical Corps.

CORRIGENDA.

For Qmr. and Hon. Lieut. Jones, Royal Army Medical Corps (T.F.), read Qmr. and Hon. Lieut. T. Jones (extra-regimentally employed).

The following names should read as now stated and not as previously published;—

No. 26813 Serjt. (Acting Staff Serjt.) F. Wills, Royal Army Medical Corps.

Jamacia.

No. 2242 Cpl. J. Thomson, Royal Army Medical Corps.

Malta.

No. 19867 Pte. (Acting Serjt.) W. S. Hughes, Royal Army Medical Corps.

List dated September 18, 1917.

Temp. Lieut.-Col. (Hon. Surg.-Col.) W. R. Smith, M.D., Royal Army Medical Corps (T.F.).

For Temp. Major J. G. Taylor, M.B., F.R.C.S., Royal Army Medical Corps, read Temp. Major G. Taylor, M.B., F.R.C.S., Royal Army Medical Corps.

ARMY MEDICAL SERVICE.

Col. Samuel G. Moores, C.B., C.M.G., to be Temporary Major-Gen. whilst employed as Director of Medical Services of an Army, dated April 8, 1918.

Major-Gen. William George Birrell, M.B., retires on retired pay, dated May 30, 1918.

Lieut.-Gen. Sir A. T. Sloggett, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., is placed on retired pay on completion of the term of his appointment as Director-General, dated June 1, 1918.

Major-Gen. (Temp. Lieut.-Gen.) T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., to be Director-General, and to be Lieut.-Gen., dated June 1, 1918.

Col. Herbert Innes Pocock, C.M.G., is placed on retired pay, dated June 2, 1918.
 Capt. George H. Stack, M.B., to be Acting Lieut.-Col. whilst in command of a Medical unit, dated January 8, 1918.
 Capt. Herbert W. Carson, M.B., relinquishes the acting rank of Lieut.-Col. and reverts to the acting rank of Major (with pay and allowances of his substantive rank), dated November 23, 1917.

ROYAL ARMY MEDICAL CORPS.

Lieut.-Col. Patrick H. Henderson, D.S.O., M.B., to be Temporary Colonel whilst employed as Assistant Director of Medical Services of a Division, dated December 27, 1917.

The undermentioned are appointed Hon. Physicians to the King :—

Dated December 26, 1917.—Lieut.-Col. L. W. Harrison, D.S.O., M.B., Royal Army Medical Corps, *vice* Col. (Hon. Surg.-Gen.) R. S. F. Henderson, C.B., M.D., retired pay; Col. E. Eckersley, M.B., Army Medical Service, *vice* Surg.-Gen. T. M. Corker, C.B., M.D., retired pay.

Dated January 27, 1918.—Col. S. Macdonald, C.M.G., M.B., Army Medical Service, *vice* Surg.-Gen. Sir W. G. Macpherson, K.C.M.G., C.B., M.B., retired pay.

The undermentioned are appointed Hon. Surgeons to the King :—

Dated December 26, 1917.—Major-Gen. (Temp. Lieut.-Gen.) T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., Army Medical Service, *vice* Col. (Hon. Surg.-Gen.) S. Hickson, C.B., M.B., retired pay; Col. E. M. Pilcher, D.S.O., M.B., F.R.C.S., Army Medical Service, *vice* Col. W. H. Horrocks, C.B., M.B., retired pay.

Major Frederick D. G. Howell, D.S.O., M.C., to be Temporary Lieutenant-Colonel whilst employed as Assistant Director of Medical Services of an Army, dated March 17, 1918; Major George E. Ferguson to be Acting Lieutenant-Colonel whilst in command of a Medical Unit, dated March 31, 1918.

The undermentioned to be Acting Lieutenant-Colonels whilst specially employed, date March 29, 1918 :—

Major Thomas J. Potter.

Temp. Capt. (Temp. Major) Frederick G. W.

Dean, F.R.C.S. Edin.

Temp. Major (Capt. R.A.M.C., T.F.) Lewis C.

Bruce, M.C., M.D., F.R.C.P.

Temp. Hon. Major William J. Richard, M.B., to be Temporary Hon. Lieutenant-Colonel whilst employed at the Merryflats War Hospital, dated March 29, 1918.

Temp. Capt. William Kennedy Taylor to be Acting Major, dated February 27, 1918. (Substituted for the notification in the *Gazette* of April 13, 1918.)

The undermentioned to be Acting Majors whilst specially employed :—

Dated March 29, 1918.—Capt. Joseph W. Houston, D.S.O., M.B., Lieut. (Temp. Capt.) Oliver B. Pratt.

The undermentioned to be Temporary Captains whilst specially employed, dated March 29, 1918 :—

James Taylor, F.R.C.S. Edin.

Arthur J. H. Boyton.

Robert Edwards, M.B.

Hugh F. Sheldon.

George Marshall, M.B.

James O'D. Egan.

William F. Law, M.D., F.R.C.S.I.

Douglas J. Glen, M.B.

John P. Duncan, M.B.

William M. Buchanan, M.B.

Duncan Fletcher.

Peter H. Macdonald, M.B.

James W. Bennett.

David W. Torrance, M.D.

James Philp.

John Porter, M.B.

Adolphe Abrahams, M.D.

John T. McCullagh, M.B.

William E. P. Phillips.

Alexander C. E. Gray, M.D.

Archibald H. M. Robertson, M.B.

Robert M. Fenn, M.B.

Denis F. O'Kelly.

John E. Power.

(Lieut.) Donald Burrows.

The undermentioned Temporary Captain to be Acting Lieutenant-Colonel :—

Dated March 29, 1918 :—(Acting Major) Henry Moore, M.C., whilst in command of a Medical Unit; Charles J. West, M.D., whilst specially employed.

The undermentioned Temporary Captains relinquish the rank of Acting Major on re-posting :—

Dated April 5, 1918.—John Watson, M.B.

Dated April 9, 1918.—Charles F. Drew, M.B.; Everard C. Abraham, M.C., M.B.

The undermentioned Captains to be Acting Majors, dated January 4, 1918 :—

Vincent T. Carruthers, M.B., F.R.C.S. Edin.

Leopold A. A. Andrews.

Herbert F. Joynt, M.B.

Owen R. McEwen.

Arthur S. Cane, M.D.

Dated February 8, 1918.—David C. Monro, M.B.

Dated March 12, 1918.—James R. Hill, M.B.

Dated March 16, 1918.—Albert Jackson, whilst specially employed.

Dated March 29, 1918.—John I. W. Morris (Reserve of Officers); Herbert G. Winter, M.C.; Robert M. Dickson, M.D.

The undermentioned Temporary Captains to be Acting Majors, dated January 4, 1918:—

George B. Holroyde.
Wilfrid V. Macaskie, M.B.
Harold B. Atlee, M.C., M.B.
Kenneth G. Fraser.
William K. McIntyre, M.C., M.B.
William H. Peacock, M.B.
William H. Welsh, M.B.
Charles G. Sutherland, M.B.
James P. Good, M.D.
Alan R. Green, M.B.
Francis C. Tibbs.
William D. Cruickshank, M.B.
Alexander C. Sturrock, M.D.
Alexander G. Anderson, M.B.
Isaac Jones, M.D.
Edward B. Gunson, M.D.
William T. Hessel, M.B.

William P. Ker.
Richard A. P. Hill, M.D.
James L. Gordon, M.D.
Lionel D. Woods.
Claude A. H. Gee, M.B.
Robert S. Dewar, M.B.
George V. Bakewell, M.B.
Lancelot G. McCune, M.B.
Samuel Campbell, M.B.
David I. Anderson, M.B.
John Alexander, M.B.
(Temp. Lieut.) Walter B. Griffin, F.R.C.S.
(Temp. Lieut.) Norman B. Stewart, M.B.
(Lieut.) John F. Bourke, M.C.
(Lieut.) St. John D. Buxton.
William A. Rogerson.

Dated January 24, 1918.—Alexander Dick, M.B.

Dated February 12, 1918.—Thomas Ferguson, M.B.

Dated February 27, 1918.—George D. Mathewson, M.B.

Dated March 2, 1918.—Johnston Hughston, M.B.; Robert K. Birnie, M.B.

Dated March 3, 1918.—Arthur P. Saint, M.C.

Dated March 12, 1918.—Robert Scott, M.B.

Dated March 15, 1918.—John H. McNicol, M.C., M.B.

Dated March 29, 1918.—William Martin, M.B.; Frederick N. Brown; James A. W. Watts, M.B.; Harry T. Newling; Francis B. Young, M.B.; William A. Wheeldon, M.B.; John D. Duncan, M.D.; Alfred Griffiths, M.B., F.R.C.S. Edin.; (Temp. Lieut.) Richard G. Oram.

Dated April 7, 1918.—Walter Crabtree, M.B.; James R. Craig, M.B.; William M. Badenock, M.B.

Dated April 11, 1918.—John H. Banks.

Dated April 18, 1918.—James A. Conway, M.C., M.D.

Dated April 20, 1918.—Alan G. Cook, M.B.

The undermentioned Temporary Majors to be Temporary Lieutenant-Colonels:—

Dated May 25, 1918.—Sir Robert Armstrong-Jones, Knt., M.D., F.R.C.P., F.R.C.S.; Hamilton C. Marr, M.D.

The undermentioned to be Acting Lieutenant-Colonels whilst in command of a Medical Unit:—

Dated December 16, 1917.—Captain Charles H. Stringer; Captain Gilbert G. Collet, M.B.; Lieut. (Temp. Capt.) Rudolf W. Galloway, M.B.

Dated January 16, 1918.—Captain Leopold T. Poole, M.C., M.B.

Dated April 1, 1918.—Major Samuel B. Smith, D.S.O., M.D.

Temp. Hon. Major Thomas E. K. Stansfield, M.B., to be Temp. Hon. Lieut.-Col., dated May 25, 1918.

Temp. Major Thomas Basil Rhodes, M.B., relinquishes his commission on ceasing to be employed with the N. Staffordshire Infirmary, dated May 20, 1918.

Temp. Capt (Acting Major) Guy W. Parry relinquishes his commission, dated March 28, 1918.

The undermentioned to be Acting Majors:—

Dated January 4, 1918.—Temp. Capt. Donovan B. Pascall, M.B.; Temp. Capt. Norman A. A. Hughes; Temp. Capt. Allan C. Hancock, M.C.; Temp. Capt. Harold J. de Brent, M.C.; Capt. Clive T. Edmunds (from January 4 to 29, 1918).

Dated April 6, 1918.—Temp. Lieut. Duncan C. Ogilvie; Temp. Capt. Robert Tindall, M.C.

Temp. Capt. William Core, M.B., is dismissed the service by sentence of a General Court-Martial, dated March 14, 1918.

The undermentioned Temporary Captains relinquish their commissions:—

Dated February 21, 1918.—Charles D. Goodenough.

Dated May 1, 1918.—William T. Evans, M.B.

Dated May 25, 1918.—William L. Christie, M.D., F.R.C.S.

Temp. Hon. Capt. William R. Carter, M.B., relinquishes his commission on ceasing to be employed with British Red Cross Society in France, dated April 25, 1918.

The undermentioned Lieutenants (Temporary Captains) to be Captains:—

Dated May 10, 1918.—Kenneth A. M. Tomory, M.B.

Dated May 11, 1918.—John S. Sloper, M.B.; Colin Wilson, M.B.; Harry N. Stafford, M.C.; Robert J. Sullivan, M.C., M.D.

Dated May 16, 1918.—Robert A. Anderson, M.B.

Dated May 28, 1918.—Frederick M. Lipscomb; Harry P. Rudolf, M.B.; Douglas N. Macleod, M.B.

BIRTH.

DENNIS.—On February 18, at Toots, Caversham, Reading, the wife of Lieut.-Col. B. R. Dennis, Royal Army Medical Corps, of a son.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adastral House, Victoria Embankment, E.C. 4.

The following publications have been received:—

British: The British Journal of Surgery, Proceedings of the Royal Society of Medicine, The Army Service Corps Journal, Tropical Diseases Bulletin, The Medical Journal of Australia, The Medical Press and Circular, The Hospital, Edinburgh Medical Journal, Journal of the Royal United Service Institution, The Indian Medical Gazette, Public Health, Veterinary Review, Tropical Veterinary Bulletin, Guy's Hospital Gazette, Sydney University Medical Journal, Annals of Tropical Medicine and Parasitology, The Medical Review, Middlesex Hospital Journal, The Journal of State Medicine, The Journal of Tropical Medicine and Hygiene.

Foreign: United States Public Health Service, The Military Surgeon, Archives Médicales Belges, Bulletin de l'Institut Pasteur, Bulletin de la Société de Pathologie Exotique, Giornale di Medicina Militare, Archives de Médecine et Pharmacie Navales, Colonies et Marine, Tidsskrift I Militær Hælsøverd.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

NUMBER OF REPRINTS	NUMBER OF PAGES	COST OF REPRINTS	COST OF EXCERPTS *	EXTRA FOR COVERS FOR REPRINTS			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
12	4	£ s. d. 0 2 9	£ s. d. 0 1 2	} 4 3	} 1 1	} 3 10	} 0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	} 4 10	} 1 6	} 4 4	} 0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	} 6 0	} 2 1	} 4 10	} 1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	} 7 10	} 3 11	} 6 7	} 2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	} 10 10	} 7 6	} 9 0	} 4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. 6d. net; binding, 2s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C.

The back outside cover is not available for advertisements.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 30th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,

"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"

25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C.4.

of the
to the
the
the
the

of the
the
the
the

the
the
the
the
the
the
the

Journal
the
the

Journal
the
the

the
the

ECA

THIS BOOK IS DUE ON THE LAST DATE
STAMPED BELOW

AN INITIAL FINE OF 25 CENTS
WILL BE ASSESSED FOR FAILURE TO RETURN
THIS BOOK ON THE DATE DUE. THE PENALTY
WILL INCREASE TO 50 CENTS ON THE FOURTH
DAY AND TO \$1.00 ON THE SEVENTH DAY
OVERDUE.

PSYCHOLOGY LIBRARY

~~SEP 22 1935~~
~~JAN 12 1976~~

~~JUN 28 1976~~

LD 21-100m-8,'34

354850

Great.

R 31

G 7

6.30

BIOLOGY
LIBRARY
G

UNIVERSITY OF CALIFORNIA LIBRARY

